WEST BRANCH OF THE
GRAND CALUMET RIVER
HAMMOND, INDIANA

FINAL
QUALITY ASSURANCE PROJECT PLAN

October 2002
Revision 1

Prepared by

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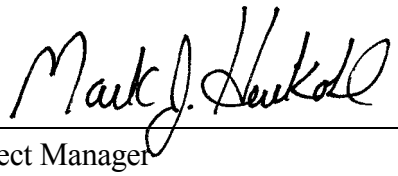
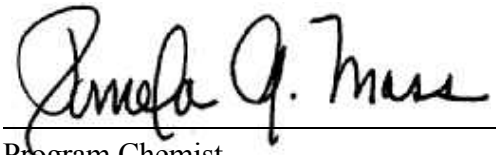


October 9, 2002

Project Manager
Mark Herrenkohl

Date



October 9, 2002

Program Chemist
Pamela Moss

Date

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ACRONYMS AND ABBREVIATIONS

%R	percent recovery
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
µmole/g	micromole per gram
ASTM	American Society for Testing and Materials
AVS-SEM	acid volatile sulfides – simultaneously extractable metals
CAS	Columbia Analytical Services, Kelso, Washington
CCV	continuing calibration verification
CIH	Certified Industrial Hygienist
CLP	Contract Laboratory Program
CRQL	Contract Required Quantitation Limit
DI	deionized water
DOC	dissolved organic carbon
DQO	Data Quality Objective
dw	dry weight
EHS	Environmental Health and Safety
EPA	U.S. Environmental Protection Agency
FCR	Field Change Request
FOL	Field Operations Lead
Foster Wheeler Environmental	Foster Wheeler Environmental Corporation
FSAP	Field Sampling and Analysis Plan
GCR	Grand Calumet River
GCRRF	Grand Calumet River Restoration Fund
ICV	initial calibration verification
IDEM	Indiana Department of Environmental Management
IDNR	Indiana Department of Natural Resources
LCS	laboratory control sample
MDL	method detection limit
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
MS	matrix spike
MSB	matrix spike blank
MSD	matrix spike duplicate

ACRONYMS AND ABBREVIATIONS (continued)

PARCC	precision, accuracy, representativeness, completeness, comparability
PCB	polychlorinated biphenyl
PESM	Project Environmental and Safety Officer
PM	Project Manager
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
RCRA	Resource Conservation and Recovery Act
RPD	relative percent difference
RSD	relative standard deviation
SD	standard deviation
SOP	Standard Operating Procedure
SOW	Statement of Work
SPCC	system performance check compounds
SVOC	semivolatile organic compound
TOC	total organic carbon
TSS	total suspended solids
USFWS	United States Fish and Wildlife Service
WBGCR	west branch of the Grand Calumet River

1. INTRODUCTION

This Quality Assurance Project Plan (QAPP) provides the quality assurance/quality control (QA/QC) requirements for sediment sampling activities to be conducted at the West Branch of the Grand Calumet River (WBGCR), Hammond, Indiana, by Foster Wheeler Environmental Corporation (Foster Wheeler Environmental) under the direction of the Grand Calumet River Restoration Fund (GCRRF) Council. The objective of this QAPP is to ensure that data quality requirements are established and fulfilled pertaining to collecting and evaluating site data. This QAPP has been prepared to define the QA and QC activities to be implemented, to ensure the integrity of the work to be performed at the site, and to ensure that the data collected will be of the appropriate type and quality needed for the intended use.

This QAPP has been prepared by Foster Wheeler Environmental in accordance with the requirements of the Scope of Work (SOW) for Task Order 02-Y037 of Contract 1448-98695-98-C008, dated February 4, 2002. The QAPP was prepared for the U.S. Fish and Wildlife Service (USFWS) Environmental and Facility Compliance Office at the request and direction of the USFWS – Bloomington Field Office as a project planning document for the implementation of the chemical, physical, and toxicological characterization of the West Branch of the Grand Calumet River (GCR), Indiana. The USFWS is acting as the contracting agency on behalf of the GCRRF Council, which is composed of USFWS, Indiana Department of Environmental Management (IDEM), U.S. Environmental Protection Agency (EPA), and Indiana Department of Natural Resources (IDNR).

This plan has been prepared and reviewed in accordance with Foster Wheeler Environmental's Corporate Quality Assurance Program (Foster Wheeler Environmental, 1995) and the EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations (External Review Draft Final) - EPA QA/R-5 (EPA, 1998). Related documents referenced in this QAPP include the Field Sampling and Analysis Plan (FSAP), which describes field sampling activities, and the Environmental Health and Safety (EHS) Plan. All field activities will be performed in compliance with the FSAP. All parties generating data under this program are responsible for implementing the requirements presented in this QAPP.

1.1 PROJECT OBJECTIVE

The objective of this project is to characterize the sediments in the WBGCR. Samples will be collected to evaluate the chemical and physical characteristics of the sediment. Surface water samples will also be collected. These samples will be analyzed for chemicals of concern and will

also be used for the elutriate and column settling tests. The data resulting from the sampling activities will be used to determine the possible need for remediation of the sediments and possible future development alternatives for remediation and restoration of the river.

1.2 PROJECT BACKGROUND

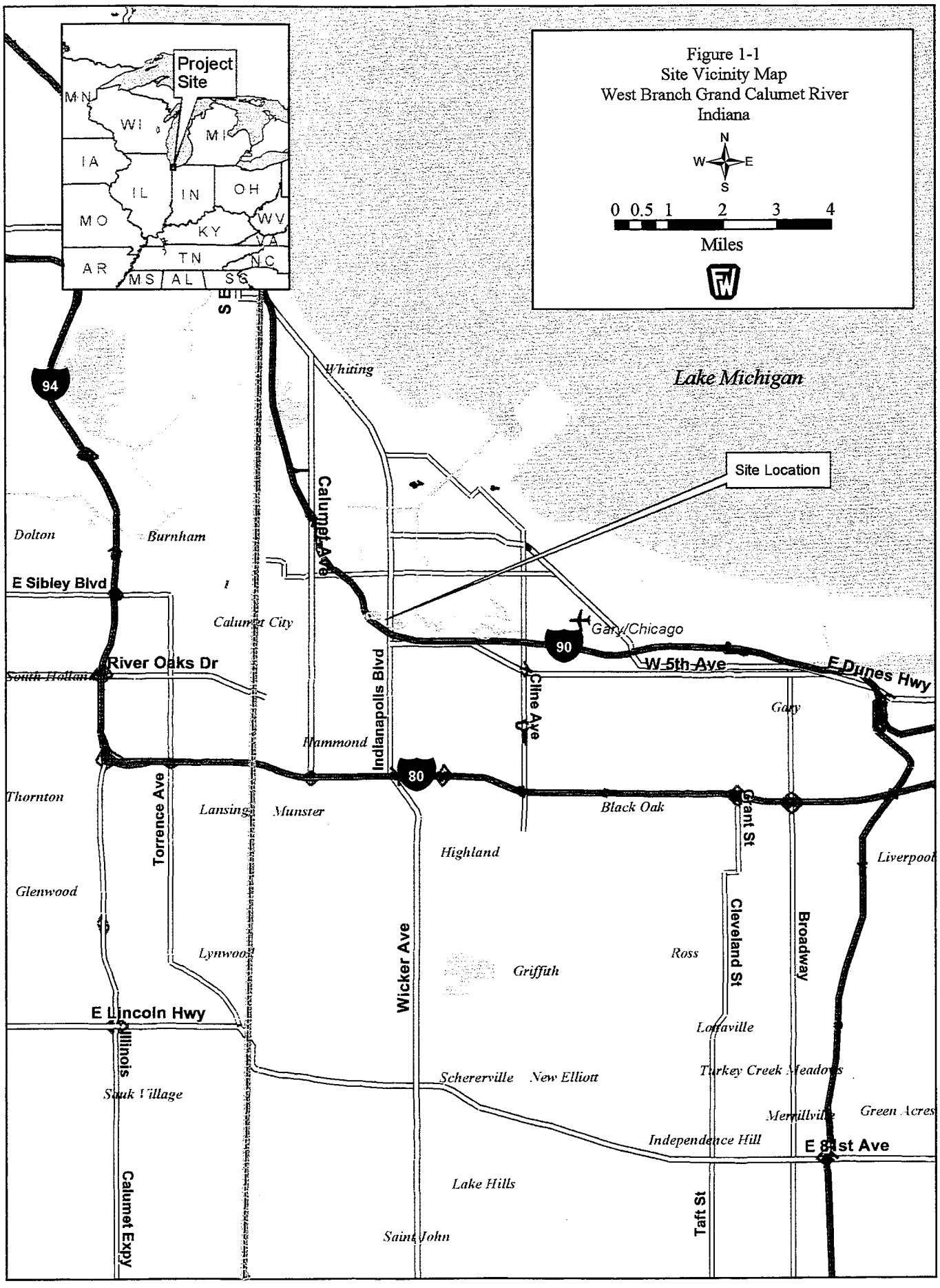
Currently, the GCRRF Council monitors activities related to this project per the Memorandum of Understanding among the EPA, USFWS, IDNR and IDEM. The goal of the parties is to address the effects of sediment contamination in the WBGCR, specifically for the purpose of addressing and correcting environmental contamination in the area of concern, including the cleanup of contaminated sediments in GCR, and the remediation and restoration of natural resource damages within the area of concern.

The Grand Calumet River is located in Lake County in northwestern Indiana (Figure 1-1). The river's watershed is relatively flat and comprises approximately 22 square miles of northern Indiana. The surrounding area, which represents one of the most heavily industrialized areas in the United States, contains steel mills and heavy manufacturing sites associated with the steel industry, petroleum-related land uses, packaging operations, chemical processing plants, and other industrial land uses. The land surrounding the river is primarily industrial and commercial interspersed with residential areas. The project area evaluated in this phase of work includes the west branch of the river extending from Indianapolis Blvd. west to the Indiana/Illinois state line.

The sediments are highly contaminated with heavy metals and various organic compounds including semivolatile organic compounds (SVOCs), chlorinated pesticides, and polychlorinated biphenyls (PCBs).

1.3 PROJECT DESCRIPTION

The primary tasks that will be completed for this project include sediment and water sample collection within the WBGCR. Sediment samples will be collected using a Vibracore technique. Water samples will be collected using a grab technique. Samples will be analyzed for project-specific parameters to evaluate the chemical and physical characteristics of the site. The chemical parameters of interest include pesticides, PCBs, PCB congeners, SVOCs, acid volatile sulfides (AVS), metals, oil and grease, and total organic carbon (TOC). Physical parameters of interest include Atterberg limits, specific gravity, moisture, and grain size.



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February 26, 2002

2. PROJECT ORGANIZATION AND RESPONSIBILITY

Although QA/QC responsibilities lie principally with the Foster Wheeler Environmental Project Manager (PM) and QA Manager, proper implementation of QA/QC requirements necessitate that the entire project staff be cognizant of all procedures and goals. A field program organization chart is presented as Figure 2-1.

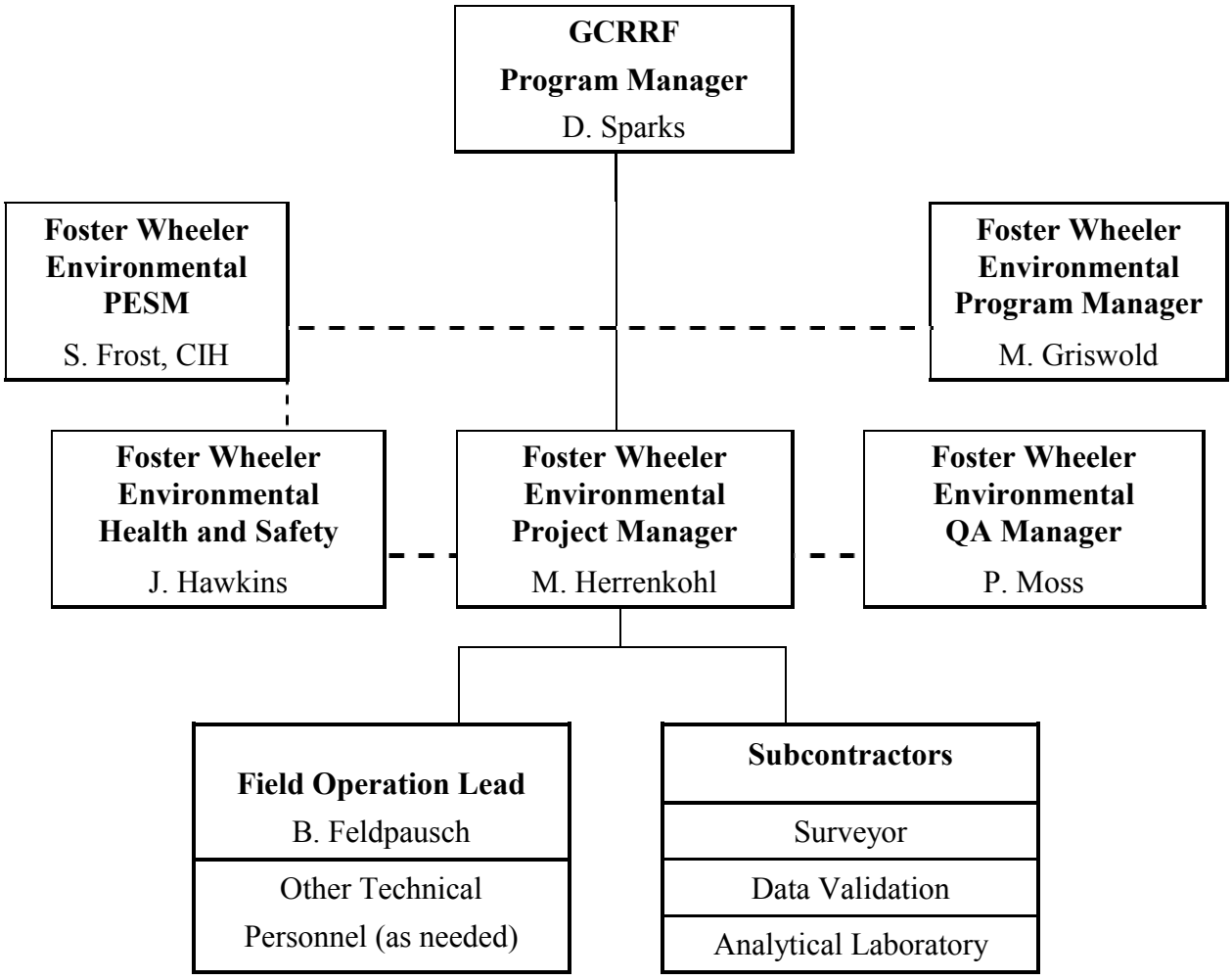
Mark Herrenkohl will be the PM for the WBGCR investigation. He will be responsible for implementing and executing the technical, QA, and administrative aspects of the investigation, including the overall management of the project team. The PM is also accountable for ensuring that the investigation is conducted in accordance with applicable plans and guidelines, including the FSAP, the QAPP, and the EHS Plan. In addition, the PM will communicate all technical, QA and administrative matters to the GCRRF Project Manager. He will ensure that any deviations from the approved FSAP, QAPP, and/or EHS Plan are documented in Field Change Request (FCR) forms, communicated to GCRRF, and approved before implementation. The PM is responsible for overseeing the preparation of project deliverables to be submitted by Foster Wheeler Environmental.

The overall management of the project-specific QA activities is the responsibility of the QA Manager, Pamela Moss. The QA Manager, or her designee, is responsible for implementation of site-specific QA activities, including field and laboratory quality control. In addition, the QA Manager or her designee will coordinate with the PM and other project staff, as applicable, during the reduction, review and reporting of analytical data.

The Field Operations Lead (FOL), Mr. Bob Feldpausch, is responsible for managing and supervising the field investigation program and providing consultation and decision-making on day-to-day issues relating to the sampling activities. The FOL shall monitor the sampling to ensure that operations are consistent with plans and procedures, and that the data acquired meets the analytical and data quality needs. When necessary, the FOL will document any deviations from the plans and procedures for approval.

The Foster Wheeler Environmental Health and Safety Manager, Ms. Jennifer Hawkins, is responsible for the implementation of the site-specific EHS Plan. The Health and Safety Manager, through the cross-trained FOL, shall advise the project staff on health and safety issues, conduct health and safety training sessions, and monitor the effectiveness of the health and safety program conducted in the field.

Figure 2-1. Program Organization Structure



The services of several subcontractors (e.g., land surveyors, laboratory services, data validation) will also be necessary for the performance of the field investigation and implementation of project objectives. The PM, with assistance from the FOL as necessary and appropriate, will be the primary liaison between Foster Wheeler Environmental, the GCRRF Project Manager, and each of the subcontractors. Subcontractors are responsible for performing work according to the requirements in this QAPP.

Severn Trent Laboratories (STL), University Park, Illinois, will perform the chemical analysis on the sediment samples collected for this project. The project manager at STL will be Mr. Eric Lang. Columbia Analytical Services in Kelso, Washington will analyze the water samples. The geotechnical analyses will be performed by Soil Technologies, Inc. (STI) in Bainbridge Island, Washington. The project manager at each laboratory will be responsible for coordination with Foster Wheeler Environmental, QAPP implementation, and analytical data quality.

3. QUALITY ASSURANCE OBJECTIVES

This section of the QAPP documents the project data quality objectives (DQOs) and establishes the performance criteria for the planning and measurement system that will be used to generate data. DQOs apply to field and analytical data, as well as data verification, reduction, and evaluation activities. The QC requirements for this project include procedures to promote data quality and collect QC samples that provide data of a measurable quality.

3.1 DATA QUALITY OBJECTIVE PROCESS

DQOs provide criteria against which project performance can be evaluated to determine whether the overall project QA objectives are met. The objectives will be met by collecting data of sufficient quality and quantity that can be used for the intended purposes. DQOs can be defined as what the end user expects to obtain from the analysis results. DQOs are developed through a seven-step process. The DQOs for this project are defined below using the seven-step process described in EPA's *Guidance for the Data Quality Objective Process* (EPA, 2000).

State the Problem. Sediment and water samples must be collected within the WBGCR to characterize the nature and extent of contamination in the river in support of restoration alternatives development and evaluation for this part of the Grand Calumet River.

Identify the Decision. A decision must be made from the data collected to determine whether target analytes are present in sediments at levels exceeding the project-specific action levels as defined by the GCRRF.

Identify Inputs to the Decision. Inputs to the decision include the following:

- Analytical data resulting from sediment and water samples collected within the river
- Project-specific action levels
- Analytical method reporting limits
- Existing data from previous site investigations (if needed)

Define the Study Boundaries. Data collected in this study will focus on the target analytes known to exist at the site. The geographic boundaries of this study include the sediment (to a depth of approximately 12 feet) and surface water at the sediment sample locations.

Develop a Decision Rule. The decision rules are defined as follows:

- If target analytes are not detected at concentrations above the Contract Required Quantitation Limit (CRQLs), no further action is required.
- If target analytes are detected above CRQLs, the data will be used to evaluate the nature and extent of contamination for the purpose of evaluating the need for remediation and/or restoration of the river sediments.

Specify Limits on Decision Errors. The decision rules will be applied using valid analytical data derived from the samples. Samples have been selected to be representative of the tests being conducted. Method data quality requirements for precision and accuracy will be used to determine the validity or usability of the data. The analytical method precision and accuracy requirements are defined in the individual laboratory procedures and laboratory quality assurance plans.

Optimize the Design for Obtaining Data. Historical information related to the source(s), the locations of the source(s), patterns of contaminant deposition, and the technical characteristics of the contaminants and the media have been utilized to determine the most cost-effective design for sample collection. This study will be performed to allow for minimization of the number and types of samples collected while supplying sufficient data upon which to apply the decision rules.

3.2 DATA ASSURANCE OBJECTIVES

The DQO process provides a logical basis for linking the QA/QC procedures to the intended use of the data, primarily through the decision maker's acceptable limits on decision error. The overall QA/QC objective for the field investigation is to develop and implement procedures that will provide data of known and documented quality. QA/QC characteristics for data include precision, accuracy, representativeness, completeness, and comparability (PARCC). This section provides a description of specific routine procedures to assess PARCC parameters. The QA objectives for analytical data for the field samples include the following, where appropriate.

3.2.1 Precision

Precision is the measurement of agreement in repeated tests of the same or identical samples, under prescribed conditions. Analytical precision can be expressed in terms of standard deviation (SD), relative standard deviation (RSD) and/or relative percent difference (RPD). The precision of analytical environmental samples has two components: laboratory precision and sampling precision. Laboratory precision is determined by replicate measurements of laboratory duplicates and by analysis of reference materials. Generally, results from the matrix spike

(MS)/matrix spike duplicate (MSD) samples and laboratory duplicate samples are used to measure laboratory precision. The precision requirements for the laboratory analyses are specified in the appropriate laboratory Standard Operating Procedures (SOPs) and analytical methodologies. The precision of the field sampling effort is determined by the analysis of field duplicate samples (see Section 9.1.1). Field duplicate analysis will be performed at a rate of 5 percent (i.e., one duplicate collected for every 20 samples).

3.2.2 Accuracy

Accuracy is the degree of agreement of a measured sample result or average of results with an accepted reference or true value. It is the quantitative measurement of the bias of a system, and it is usually expressed in terms of percent recovery (%R). The accuracy of the sample analyses will be determined in accordance with the specifications contained in the laboratory SOPs established through the evaluation of surrogate spike, MS and/or MSD samples.

3.2.3 Representativeness

Representativeness expresses the degree to which the results of the analyses accurately and precisely represent a characteristic of a population, a process condition, or an environmental condition. In this case, representativeness is the degree to which the data reflect the contaminants present and their concentration magnitudes in the sampled site areas. Representativeness of data will be ensured through the selection of proper sampling locations and implementation of approved sampling procedures. Results from environmental field duplicate sample analyses can be used to assess representativeness, in addition to precision.

3.2.4 Comparability

Comparability represents the degree of confidence with which results from two or more data sets, or two or more laboratories, may be compared. To achieve comparability, standard environmental methodologies (as prescribed in the procedures outlined in the FSAP, the QAPP, and the laboratory SOPs) will be employed in the field and in the laboratory.

3.2.5 Completeness

Completeness is defined as the percentage of samples that meet or exceed all the criteria objective levels for accuracy, precision and reporting limits within a defined time period or event. It is the measure of the number of data "points" that are judged as valid, usable results. Completeness can be ensured by collecting an adequate number of samples to accomplish project objectives.

4. OVERVIEW OF FIELD INVESTIGATION ACTIVITIES

The scope of the proposed field activities for the sediment/water sample collection and field investigation includes Vibracore sediment sample collection and surface water grab sample collection. Rational and procedures describing these activities are presented in the FSAP. In addition, decontamination procedures for sampling equipment are also provided in the FSAP.

5. SAMPLE MANAGEMENT

Identification and documentation of samples are important in maintaining data quality. Strict custody procedures are necessary to ensure the integrity of the environmental samples. Sample custody must be strictly maintained and carefully documented each time the sample material is collected, transported, received, prepared, and analyzed. The history of each sample and its handling must be documented from its collection through all transfers of custody to ensure the integrity of the sample. A "sample" shall be defined as a piece of physical evidence collected from a facility or the environment. The control of the sample is essential to this evidentiary information. The subsections below address sample identification, custody, and documentation.

5.1 SAMPLE IDENTIFICATION

The method of identification of a sample depends on the type of measurement or analysis performed. When field in situ measurements (e.g., water temperature or conductivity) are made, data are recorded directly in logbooks or on field investigation forms. Identifying information such as project name, station number, station location, date and time, name of sampler, field observations and remarks, etc., shall be recorded.

Samples that cannot be analyzed in place must be removed and transported from the sample location to a laboratory or other location for analysis. Each sample collected for off-site laboratory analysis during the field investigation will be specifically designated by Foster Wheeler Environmental for unique identification (refer to FSAP). Information to be recorded on the sample label includes the project name, sample identification number (assigned by Foster Wheeler Environmental), sample location, date and time of sample acquisition, type and matrix of sample (including designation of grab or composite), analysis required, preservation (as necessary), and name of sampler.

Sample identification numbers shall be assigned using at least a project identifier code (e.g., "WB" for West Branch of the Grand Calumet River), a letter code designating the type of sample (e.g., "CS" for core sample, etc.), and a number designating the sample location (e.g., "1" for Vibracore station 1). Details of the sample identification numbers are included in the FSAP.

5.2 SAMPLE CUSTODY

Sample custody must be strictly maintained and carefully documented each time the sample material is collected, transported, received, prepared, and analyzed. Custody procedures are necessary to ensure the integrity of the samples. Samples collected during the field investigation

must be traceable from the time the samples are collected until they are disposed of and/or stored at the laboratory.

5.2.1 Field Custody Procedures

The field custody procedures are outlined below. These procedures shall be implemented for each sample collected. The field sampler shall be responsible for the care and custody of the samples until they are properly transferred or dispatched. To assure the integrity of the samples, the samples are to be maintained in a designated, secure area and/or be custody sealed in the appropriate containers prior to shipment. The following procedures should be followed to ensure the integrity of all samples collected.

- All samples should be collected as described in the FSAP.
- Sample information should be documented in the field logbook(s) and on field investigation forms (as necessary).
- Sample labels should be completed for each sample using waterproof ink unless prohibited by weather conditions (e.g., a logbook notation would explain that a pencil was used to fill out the sample label because a ballpoint pen would not function in freezing weather) with the information outlined in Section 5.1. The sample label should be securely attached to the sample container.
- A chain-of-custody form should be completed, listing all appropriate samples.

5.2.2 Transfer of Custody and Shipment

The procedures for transfer of sample custody and shipment of samples to the laboratory are outlined below. All samples collected for off-site analysis must follow these procedures.

- Samples shall be accompanied by a completed chain-of-custody record during transport, either supplied by the laboratory or by Foster Wheeler Environmental. When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the record. This form documents sample custody transfer from the sampler, often through another person, to the analyst in the laboratory.
- Samples will be packaged properly for shipment and dispatched to the appropriate laboratory for analysis, with a separate chain-of-custody record accompanying each shipment of coolers. To ensure the integrity of the samples, the samples are to be maintained in a designated, secure area and/or be custody sealed in the appropriate containers prior to shipment. The samples shall be placed in a metal or hard plastic cooler, filled with adequate cushioning material to minimize the possibility of container

breakage. Samples are to be packed with sufficient ice to cool the samples to 4°C ± 2°C. Shipping containers will be custody sealed for shipment to the laboratory (as appropriate).

When a courier service is collecting the samples directly from the Site, the chain of custody form shall not be placed inside the cooler. The sample coolers shall be secured with custody seals affixed over the lid opening in at least two locations and the cooler wrapped with strapping tape (without obscuring the custody seals). Orientation "This End Up" arrows shall be drawn or attached on two sides of the cooler. The chain of custody form must be signed by the courier as receiving possession of the samples. Samples shall be transported to the laboratory within 48 hours of sample collection.

When the samples are being shipped by an overnight delivery service to the laboratory, the chain of custody form and any other paperwork shall be placed in a waterproof sealable plastic bag and taped securely to the inside lid of the cooler. The cooler must then be secured, with custody seals affixed over the lid opening in at least two locations, and the cooler wrapped with strapping tape (without obscuring the custody seals). Orientation "This End Up" arrows shall be drawn or attached on two sides of the cooler, and a completed overnight delivery service shipping label shall be attached to the top of the cooler. Wide, clear tape should be used to secure the label to the cooler to prevent the shipping address label from being accidentally peeled off the cooler top. Samples to be shipped by an overnight delivery service shall be shipped within 24 hours of sample collection and arrive at the laboratory within 24 hours of sample shipment. A member of the field team will contact the laboratory to notify them of the sample shipment.

A copy of the chain-of-custody form will be retained by Foster Wheeler Environmental in the project files.

5.2.3 Laboratory Custody Procedures

The following list summarizes laboratory custody procedures. More detailed protocols are presented in the specific SOPs.

- A designated sample custodian will accept custody of the shipped samples and will verify that the information on the sample labels matches that on the chain of custody record(s).
- The laboratory custodian will use the sample label number or assign a unique laboratory number to each sample label. The laboratory custodian will also assure that all samples are transferred to the proper analyst or stored in the appropriate secure area.

- Laboratory personnel are responsible for the care and custody of samples from the time they are received until the sample is exhausted or returned to the custodian or sample storage area. The laboratory shall maintain internal chain of custody records.

The laboratory shall communicate with Foster Wheeler Environmental personnel by telephone or electronic mail (email), as necessary, throughout the process of sample scheduling, shipment, analysis, and data reporting, to ensure that samples are properly processed. If a problem occurs during sample shipment or receipt (i.e., a sample container arrives broken or with insufficient sample volume, a sample was not preserved correctly, a sample was not listed on the chain of custody, etc.), the laboratory shall immediately notify the Foster Wheeler Environmental Project Chemist or designee by telephone or email for resolution. Corrective actions shall be documented and approved before implementation (see Section 13).

When sample analyses and necessary QA checks have been completed in the laboratory, the unused portion of the sample and the sample container must be disposed of properly. All identifying tags, data sheets, and laboratory records shall be retained as part of the permanent documentation. Samples received by the laboratory will be retained until analyses and QA checks are completed.

5.3 SAMPLE DOCUMENTATION

Sampling information will be documented in field logbooks and on field forms. The sampling team or any individual performing a particular field investigation activity shall be required to maintain a field logbook. The field logbook shall be a bound weatherproof notebook, and entries to the logbook must be filled out legibly in ink. Pertinent information that will be recorded in field logbooks includes all information that is necessary to reconstruct the investigative/sampling operations. Documentation of sample activities in the field logbook shall be completed immediately after sampling at the location of sample collection. Logbook entries shall contain all sample information, including sample number (and duplicate sample number as applicable), collection time, location, descriptions, field measurements, and other site- or sample-specific observations. Difficulties with sample recovery and field observations (e.g., staining, visible contamination, etc.) must be noted if encountered.

Logbook pages shall be consecutively numbered, and upon entry of data, the logbook pages require the date and the signature of the responsible project team member at the bottom of each page. Corrections to the logbooks shall consist of a single strike line through the incorrect entry, the new accurate information, the initials of the corrector, and the date of amendment. Any blank spaces/pages in the logbooks shall be crossed out with a single strike mark and signed by the person making the notation.

If photographs are taken as part of the documentation procedure, the name of the photographer, the date, the time, the site name, the site location, and a description of the photo shall be entered sequentially in the field logbook as the photographs are taken. Once developed, the photographic prints shall be numbered in correspondence to the logbook numbers, and the above information shall be placed on the back of the photograph.

In addition to field logbooks, field team members will use appropriate forms applicable to the field activities (as necessary). Investigation forms may include boring logs, vessel logs, rig shift reports, or calibration/maintenance records. Chain of custody forms shall be used for all sample shipments. These forms are described in Section 5.2.2. Examples can also be found in the FSAP.

6. ANALYTICAL REQUIREMENTS

This section describes the analytical methods that will be used by the laboratory and the method requirements. A sampling and analysis summary is provided in Table 6-1. Specific details for the analytical methods are contained in the laboratory SOPs. The laboratories will analyze samples using methods that are capable of achieving the target analyte CRQLs specified in Tables 6-2 and 6-3. Only methods listed in this QAPP will be used to analyze project samples, unless prior written approval is obtained from the Foster Wheeler Environmental PM (in conjunction with the GCRRF).

6.1 ANALYTICAL METHODS

Analytical testing of the project samples, as summarized in Table 6-1, will be performed by STL Laboratories, Inc. The samples will be analyzed in accordance with the EPA method requirements as defined in the laboratory-specific SOPs. Laboratories will follow their SOPs for sample preparation, instrument maintenance, instrument calibration, and sample handling.

The project-specific analytical parameters and associated methods to be used by the STL are as follows:

- PCBs — SW846 8082
- PCB Congeners — SW846 8082 Mod.
- Pesticides — SW846 8081A
- SVOCs — SW846 8270C
- Resource Conservation and Recovery Act (RCRA) Metals — SW846 6010B Trace, 7471A
- RCRA Metals in water (or equivalent methods to meet CRQLs) — EPA 200.10, 200.12, 200.13, 245.2
- Oil and Grease — SW846 9071B
- TOC — EPA 415.1/9060
- Dissolved Organic Carbon (DOC) — EPA 415.1
- Total Suspended Solids (TSS) — EPA 160.2

• Acid-Volatile Sulfides – Simultaneously Extractable Metals (AVS-SEM)	EPA Draft 1629
• Grain size	ASTM D 422 with hydrometer
• Atterberg Limits	ASTM D 4318-95
• Specific Gravity	ASTM D 854-92
• Moisture Content/Bulk Density	ASTM D 2216
• Laboratory UU Triaxial Shear	ASTM D 2850
• Consolidation	ASTM D 2435-90
• Direct Shear	ASTM D 3080
• Dredge Elutriate Test	DiGiano et al., 1995
• Modified Elutriate Test	USEPA/USACE 1998
• Column Settling	USEPA/USACE 1998

6.2 ANALYTICAL METHOD LIMITS OF DETECTION

Reporting limits for the analytical laboratory methods are defined in the method protocols presented above. Laboratory reporting limits will meet the requirements of the project CRQLs as listed in Tables 6-2 and 6-3. Sediment analytical data results shall be presented either in units of micrograms per kilogram (µg/kg) dry weight (dw) or milligrams per kilogram (mg/kg) dw. Water analytical data will be reported in units of micrograms per liter (µg/L) or milligrams per liter (mg/L).

6.3 SAMPLE PRESERVATION

Samples for the analytical laboratory are to be preserved (which includes ice to 4^{o}C) prior to transportation and storage to prevent retard degradation or modification of chemicals in the samples. Specified holding times should also be met to maintain the integrity of the sample.

Requirements for the sample containers, preservatives, and holding times to be used during the investigation are provided in Table 6-4. The procedures for the cleanliness of the containers are given in the SOPs of the analytical laboratory.

Table 6-1. Sampling and Analysis Summary for the West Branch of the Grand Calumet River

Sample Matrix	Laboratory Analysis	No. of Samples*	Field QA Samples		Lab QA Samples	Total
			Environmental Duplicates	Equipment Blanks	MS/MSD Samples	
Sediment						
	SVOCs	88	5	5	5/5	108
	Pesticides	88	5	5	5/5	108
	PCBs	88	5	5	5/5	108
	PCB Congeners	88	5	5	5/5	108
	RCRA Metals	88	5	5	5/5	108
	Oil and Grease	84	5	5	5/5	104
	TOC	88	5	5	5/5	108
	AVS-SEM	84	5	5	5/5	104
	Grain Size	50	3	NA	NA	53
	Atterburg Limits	25	1	NA	NA	26
	Specific Gravity	25	1	NA	NA	26
	Moisture Content/Bulk Density	25	1	NA	NA	26
	Laboratory UU Triaxial Shear	14	NA	NA	NA	14
	Consolidation	14	NA	NA	NA	14
	Direct Shear	7	NA	NA	NA	7
	Dredge Elutriate Test	4	NA	NA	NA	4
	Modified Elutriate Test	4	NA	NA	NA	4
	Column Settling	2	NA	NA	NA	2
Water						
	Total SVOCs	10	NA	NA	1/1	12
	Dissolved SVOCs	10	NA	NA	NA	10
	Total Pesticides	10	NA	NA	1/1	12
	Dissolved Pesticides	10	NA	NA	NA	10
	Total PCBs	10	NA	NA	1/1	12
	Dissolved PCBs	10	NA	NA	NA	10
	Total RCRA Metals	10	NA	NA	1/1	12
	Dissolved RCRA Metals	10	NA	NA	NA	10
	DOC	10	NA	NA	1/1	12
	TOC	10	NA	NA	NA	10
	Total Suspended Solids	10	NA	NA	NA	10

* Estimated number of samples. Actual number will change during field activities. Additional sediment samples may be archived.
The number of environmental duplicates and MS/MSD samples will be dependent on the number of field samples collected, and shall be analyzed at a rate of 5 percent (1 per 20).

Table 6-2. Target Analytes and Contract Required Quantitation Limits for Sediment Samples

Parameter (Method)	Target Analytes	CRQL	Units
PCBs	Aroclor-1016	80	µg/kg
(SW846 8082)	Aroclor-1221	80	µg/kg
	Aroclor-1232	80	µg/kg
	Aroclor-1242	80	µg/kg
	Aroclor-1248	60	µg/kg
	Aroclor-1254	160	µg/kg
	Aroclor-1260	160	µg/kg
PCB Congeners **	2-Chlorobiphenyl	20	µg/kg
(SW846 8082 Mod.)	4-Chlorobiphenyl	20	µg/kg
	2,3-Dichlorobiphenyl	1	µg/kg
	2,4'-Dichlorobiphenyl	1	µg/kg
	4,4'-Dichlorobiphenyl	5	µg/kg
	2,2',5-Trichlorobiphenyl	1	µg/kg
	2,2,4'-Trichlorobiphenyl	10	µg/kg
	2,4',5-Trichlorobiphenyl	10	µg/kg
	3,4,4'-Trichlorobiphenyl	1	µg/kg
	2,2',3,5'-Tetrachlorobiphenyl	1	µg/kg
	2,2',4,5'-Tetrachlorobiphenyl	1	µg/kg
	2,2',5,5'-Tetrachlorobiphenyl	1	µg/kg
	2,3',4,4'-Tetrachlorobiphenyl	1	µg/kg
	2,3',4',5-Tetrachlorobiphenyl	1	µg/kg
	2,4,4',5-Tetrachlorobiphenyl	1	µg/kg
	3,3',4,4'-Tetrachlorobiphenyl	1	µg/kg
	3,4,4',5-Tetrachlorobiphenyl	1	µg/kg
	2,2',3,4,5'-Pentachlorobiphenyl	1	µg/kg
	2,2',3,4',5-Pentachlorobiphenyl	1	µg/kg
	2,2',4,4',5-Pentachlorobiphenyl	1	µg/kg
	2,2',4,5,5'-Pentachlorobiphenyl	1	µg/kg
	2,3,3',4,4'-Pentachlorobiphenyl	1	µg/kg
	2,3,3',4',6-Pentachlorobiphenyl	1	µg/kg
	2,3,4,4',5-Pentachlorobiphenyl	1	µg/kg

Table 6-2. Target Analytes and Contract Required Quantitation Limits for Sediment Samples

Parameter (Method)	Target Analytes	CRQL	Units
PCB Congeners	2,3,4,4',6-Pentachlorobiphenyl	1	µg/kg
(SW846 8082 Mod.)	2,3',4,4',5-Pentachlorobiphenyl	1	µg/kg
	2,3',4,4',6-Pentachlorobiphenyl	1	µg/kg
	2,3',4,4',5'-Pentachlorobiphenyl	1	µg/kg
	3,3',4,4',5-Pentachlorobiphenyl	1	µg/kg
	2,2',3,3',4,4'-Hexachlorobiphenyl	1	µg/kg
	2,2',3,4,4',5-Hexachlorobiphenyl	1	µg/kg
	2,2',3,4,5,5'-Hexachlorobiphenyl	1	µg/kg
	2,2',3,4',5',6-Hexachlorobiphenyl	1	µg/kg
	2,2',3,5,5',6-Hexachlorobiphenyl	1	µg/kg
	2,2',4,4',5,5'-Hexachlorobiphenyl	1	µg/kg
	2,3,3',4,4',5-Hexachlorobiphenyl	1	µg/kg
	2,3,3',4,4',5'-Hexachlorobiphenyl	1	µg/kg
	2,3,3',4,4',6-Hexachlorobiphenyl	1	µg/kg
	2,3',4,4',5,5'-Hexachlorobiphenyl	1	µg/kg
	2,3',4,4',5',6-Hexachlorobiphenyl	1	µg/kg
	3,3',4,4',5,5'-Hexachlorobiphenyl	1	µg/kg
	2,2',3,3',4,4',5-Heptachlorobiphenyl	1	µg/kg
	2,2',3,3',4,5',6'-Heptachlorobiphenyl	1	µg/kg
	2,2',3,4,4',5,5'-Heptachlorobiphenyl	1	µg/kg
	2,2',3,4,4',5',6-Heptachlorobiphenyl	1	µg/kg
	2,2',3,4,4',6,6'-Heptachlorobiphenyl	1	µg/kg
	2,2',3,4',5,5',6-Heptachlorobiphenyl	1	µg/kg
	2,3,3',4,4',5,5'-Heptachlorobiphenyl	1	µg/kg
	2,2',3,3',4,4',5,5'-Octachlorobiphenyl	1	µg/kg
	2,2',3,3',4,4',5,6-Octachlorobiphenyl	1	µg/kg
	2,2',3,3',4,5',6,6'-Octachlorobiphenyl	1	µg/kg
	2,2',3,3',4,5,5',6'-Octachlorobiphenyl	1	µg/kg
	2,2',3,3',5,5',6,6'-Octachlorobiphenyl	1	µg/kg
	2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl	1	µg/kg
	2,2',3,3',4,4',5,6,6'-Nonachlorobiphenyl	1	µg/kg
	2,2',3,3',4,4',5,5',6,6'-Decachlorobiphenyl	1	µg/kg

Table 6-2. Target Analytes and Contract Required Quantitation Limits for Sediment Samples

Parameter (Method)	Target Analytes	CRQL	Units
Pesticides	Aldrin	8	µg/kg
(SW846 8081A)	alpha-BHC	8	µg/kg
	beta-BHC	8	µg/kg
	delta-BHC	8	µg/kg
	gamma-BHC (Lindane)	8	µg/kg
	alpha-Chlordane	80	µg/kg
	gamma-Chlordane	80	µg/kg
	4,4'-DDD	16	µg/kg
	4,4'-DDE	16	µg/kg
	4,4'-DDT	16	µg/kg
	Dieldrin	16	µg/kg
	Endosulfan I	8	µg/kg
	Endosulfan II	16	µg/kg
	Endosulfan sulfate	16	µg/kg
	Endrin	16	µg/kg
	Endrin Ketone	16	µg/kg
	Heptachlor	8	µg/kg
	Heptachlor Epoxide	8	µg/kg
	Methoxychlor	80	µg/kg
	Toxaphene	160	µg/kg
SVOCs	Acenaphthene	330	µg/kg
(SW846 8270C)	Acenaphthalene	330	µg/kg
	Aniline	330*	µg/kg
	Anthracene	330	µg/kg
	Benzidine	1600*	µg/kg
	Benzo(a)anthracene	330	µg/kg
	Benzo(a)pyrene	330	µg/kg
	Benzo(b)fluoranthene	330	µg/kg
	Benzo(g,h,i)perylene	330	µg/kg
	Benzo(k)fluoranthene	330	µg/kg
	Benzoic Acid	1600*	µg/kg
	Benzyl Alcohol	660	µg/kg

Table 6-2. Target Analytes and Contract Required Quantitation Limits for Sediment Samples

Parameter (Method)	Target Analytes	CRQL	Units
	Bis(2-chloroethoxy)methane	330	µg/kg
	Bis(2-chloroethyl)ether	330	µg/kg
	Bis(2-chloroisopropyl)ether	330	µg/kg
	Bis(2-ethylhexyl)phthalate	330	µg/kg
	4-Bromophenyl phenyl ether	330	µg/kg
	Butylbenzyl phthalate	330	µg/kg
	Carbazole	1600	µg/kg
	4-Chloro-3-methyl-phenol	660	µg/kg
	4-Chloroaniline	660	µg/kg
	2-Chloronaphthalene	330	µg/kg
	2-Chlorophenol	330	µg/kg
	4-Chlorophenyl phenyl ether	330	µg/kg
	Chrysene	330	µg/kg
	Di-N-butyl phthalate	330	µg/kg
	Di-N-octyl phthalate	330	µg/kg
	Dibenzo(a,h)anthracene	330	µg/kg
	Dibenzofuran	330	µg/kg
	1,2-Dichlorobenzene	330	µg/kg
	1,3-Dichlorobenzene	330	µg/kg
	1,4-Dichlorobenzene	330	µg/kg
	3,3'-Dichlorobenzidine	660*	µg/kg
	2,4-Dichlorophenol	330	µg/kg
	Diethyl phthalate	330	µg/kg
	Dimethyl phthalate	330	µg/kg
	2,4-Dimethyl phenol	330	µg/kg
	1,3-Dinitrobenzene	1600	µg/kg
	1,4-Dinitrobenzene	1600	µg/kg
	4,6-Dinitro-2-methylphenol	1600*	µg/kg
	2,4-Dinitrophenol	1600*	µg/kg
	2,4-Dinitrotoluene	330	µg/kg
	2,6-Dinitrotoluene	330	µg/kg

Table 6-2. Target Analytes and Contract Required Quantitation Limits for Sediment Samples

Parameter (Method)	Target Analytes	CRQL	Units
	1,2-Diphenylhydrazine	330	µg/kg
	Fluoranthene	330	µg/kg
	Fluorene	330	µg/kg
	Hexachlorobenzene	330	µg/kg
	Hexachlorobutadiene	330	µg/kg
	Hexachlorocyclopentadiene	330	µg/kg
	Hexachloroethane	330	µg/kg
	Indeno(1,2,3-cd)pyrene	330	µg/kg
	Isophorone	330	µg/kg
	2-Methylnaphthalene	330	µg/kg
	3-Methylphenol	330	µg/kg
	4-Methylphenol	330	µg/kg
	Naphthalene	330	µg/kg
	2-Nitroaniline	1600*	µg/kg
	3-Nitroaniline	1600*	µg/kg
	4-Nitroaniline	1600*	µg/kg
	Nitrobenzene	330	µg/kg
	2-Nitrophenol	330	µg/kg
	4-Nitrophenol	1600*	µg/kg
	N-Nitrosodi-n-propylamine	330	µg/kg
	N-Nitrosodimethylamine	330*	µg/kg
	N-Nitrosodiphenylamine	330	µg/kg
	Pentachlorophenol	1600*	µg/kg
	Phenanthrene	330	µg/kg
	Phenol	330	µg/kg
	2-Picoline	1600	µg/kg
	Pyrene	330	µg/kg
	Pyridine	330*	µg/kg
	1,2,3,4-Tetrachlorobenzene	330	µg/kg
	1,2,4,5-Tetrachlorobenzene	330	µg/kg
	2,3,4,6-Tetrachlorophenol	1600	µg/kg
	2,4-Toluenediamine	1600	µg/kg

Table 6-2. Target Analytes and Contract Required Quantitation Limits for Sediment Samples

Parameter (Method)	Target Analytes	CRQL	Units
	1,2,4-Trichlorobenzene	330	µg/kg
	2,4,5-Trichlorophenol	1600*	µg/kg
	2,4,6-Trichlorophenol	330	µg/kg
RCRA Metals	Arsenic	5.0	mg/kg
(SW846 6010B)	Barium	5.0	mg/kg
	Cadmium	1.0	mg/kg
	Chromium	5.0	mg/kg
	Lead	5.0	mg/kg
	Selenium	1.0	mg/kg
	Silver	5.0	mg/kg
(SW846 7471A)	Mercury	0.2	mg/kg
Oil and Grease (SW846 9071B)	Oil and Grease	0.05	mg/kg
TOC (SW846 9060 modified)	Total Organic Carbon	500	mg/kg
Acid Volatile Sulfides –	Cadmium	0.0016	µmole/g
Simultaneously Extracted Metals	Copper	0.0094	µmole/g
(AVS-SEM) (EPA Draft 1629)	Lead	0.0014	µmole/g
	Nickel	0.0051	µmole/g
	Zinc	0.018	µmole/g
	Antimony	0.0049	µmole/g
	Arsenic	0.0080	µmole/g
	Chromium	0.0035	µmole/g
	Silver	0.0028	µmole/g
	Mercury	0.018	µmole/g
Grain Size (ASTM D 422)	Grain size	0.1	% retained
Atterburg Limits (ASTM D 4318-95)	Atterburg Limits	NA	NA
Specific Gravity (ASTM D 854-92)	Specific Gravity	NA	NA
Moisture Content/Bulk Density (ASTM D 2216)	Moisture Content/Bulk Density	0.1	%
Laboratory UU Triaxial Shear (ASTM D 2850)	Shear Strength	NA	NA

Table 6-2. Target Analytes and Contract Required Quantitation Limits for Sediment Samples

Parameter (Method)	Target Analytes	CRQL	Units
Consolidation (ASTM D 2435-90)	Consolidation	NA	NA
Direct Shear (ASTM D 3080)	Shear Strength	NA	NA
Dredge Elutriate Test (DiGiano et al. 1995)	Elutriate Test	NA	NA
Modified Elutriate Test (USEPA/USACE 1998)	Elutriate Test	NA	NA
Column Settling (USEPA/USACE 1998)	Column Settling	NA	NA

Notes:
* = Laboratory reporting limit may not meet the project CRQL. Laboratory will report to the method detection limit with results qualified as estimated.
** = Laboratory reporting limits are listed instead of project CRQLs for the PCB congeners.
CRQL = Contract Required Quantitation Limit as specified in Technical Specifications for the Grand Calumet River Restoration Fund Council with the exception of oil and grease, TOC, and AVS-SEM with detection limits from STL Laboratories, Inc.
mg/kg = milligrams per kilograms
µg//kg = micrograms per kilograms
µmole/g = micromole per gram

Table 6-3. Target Analytes and Contract Required Quantitation Limits for Water Samples

Parameter (Method)	Target Analytes	CRQL	Units
Total or Dissolved PCBs	Aroclor-1016	0.010	µg/L
(SW846 8082)	Aroclor-1221	0.010	µg/L
	Aroclor-1232	0.010	µg/L
	Aroclor-1242	0.010	µg/L
	Aroclor-1248	0.010	µg/L
	Aroclor-1254	0.010	µg/L
	Aroclor-1260	0.010	µg/L
Total or Dissolved Pesticides	Aldrin	0.050	µg/L
(SW846 8080)	alpha-BHC	0.050	µg/L
	beta-BHC	0.050	µg/L
	delta-BHC	0.050	µg/L
	gamma-BHC (Lindane)	0.050	µg/L
	alpha-Chlordane	0.004*	µg/L
	gamma-Chlordane	0.050	µg/L
	4,4'-DDD	0.001*	µg/L
	4,4'-DDE	0.001*	µg/L
	4,4'-DDT	0.001*	µg/L
	Dieldrin	0.050	µg/L
	Endosulfan I	0.050	µg/L
	Endosulfan II	0.050	µg/L
	Endosulfan sulfate	0.050	µg/L
	Endrin	0.030	µg/L
	Endrin Ketone	0.050	µg/L
	Heptachlor	0.0030*	µg/L
	Heptachlor Epoxide	0.0030*	µg/L
	Methoxychlor	0.050	µg/L
	Toxaphene	0.0002*	µg/L
Total or Dissolved SVOCs	Acenaphthene	10	µg/L
(SW846 8270C)	Acenaphthalene	10	µg/L
	Aniline	10*	µg/L
	Anthracene	10	µg/L

Table 6-3. Target Analytes and Contract Required Quantitation Limits for Water Samples

Parameter (Method)	Target Analytes	CRQL	Units
	Benzidine	10*	µg/L
	Benzo(a)anthracene	10	µg/L
	Benzo(a)pyrene	10	µg/L
	Benzo(b)fluoranthene	10	µg/L
	Benzo(g,h,i)perylene	10	µg/L
	Benzo(k)fluoranthene	10	µg/L
	Benzoic Acid	50	µg/L
	Benzyl Alcohol	20	µg/L
	Bis(2-chloroethoxy)methane	10	µg/L
	Bis(2-chloroethyl)ether	10	µg/L
	Bis(2-chloroisopropyl)ether	10	µg/L
	Bis(2-ethylhexyl)phthalate	10	µg/L
	4-Bromophenyl phenyl ether	10	µg/L
	Butylbenzyl phthalate	10	µg/L
	Carbazole	50	µg/L
	4-Chloro-3-methyl-phenol	20	µg/L
	4-Chloroaniline	20	µg/L
	2-Chloronaphthalene	10	µg/L
	2-Chlorophenol	10	µg/L
	4-Chlorophenyl phenyl ether	10	µg/L
	Chrysene	10	µg/L
	Di-N-butyl phthalate	10	µg/L
	Di-N-octyl phthalate	10	µg/L
	Dibenzo(a,h)anthracene	10	µg/L
	Dibenzofuran	10	µg/L
	1,2-Dichlorobenzene	10	µg/L
	1,3-Dichlorobenzene	10	µg/L
	1,4-Dichlorobenzene	10	µg/L
	3,3'-Dichlorobenzidine	10*	µg/L
	2,4-Dichlorophenol	10	µg/L

Table 6-3. Target Analytes and Contract Required Quantitation Limits for Water Samples

Parameter (Method)	Target Analytes	CRQL	Units
	Diethyl phthalate	10	µg/L
	Dimethyl phthalate	10	µg/L
	2,4-Dimethyl phenol	10	µg/L
	1,3-Dinitrobenzene	50	µg/L
	1,4-Dinitrobenzene	50	µg/L
	4,6-Dinitro-2-methylphenol	50	µg/L
	2,4-Dinitrophenol	50	µg/L
	2,4-Dinitrotoluene	10	µg/L
	2,6-Dinitrotoluene	10	µg/L
	1,2-Diphenylhydrazine (Azobenzene)	10	µg/L
	Fluoranthene	10	µg/L
	Fluorene	10	µg/L
	Hexachlorobenzene	10	µg/L
	Hexachlorobutadiene	10	µg/L
	Hexachlorocyclopentadiene	10	µg/L
	Hexachloroethane	10	µg/L
	Indeno(1,2,3-cd)pyrene	10	µg/L
	Isophorone	10	µg/L
	2-Methylnaphthalene	10	µg/L
	3-Methylphenol	10	µg/L
	4-Methylphenol	10	µg/L
	Naphthalene	10	µg/L
	2-Nitroaniline	50	µg/L
	3-Nitroaniline	50	µg/L
	4-Nitroaniline	50	µg/L
	Nitrobenzene	10	µg/L
	2-Nitrophenol	10	µg/L
	4-Nitrophenol	50	µg/L
	N-Nitrosodipropylamine	10	µg/L
	N-Nitrosodimethylamine	10*	µg/L

Table 6-3. Target Analytes and Contract Required Quantitation Limits for Water Samples

Parameter (Method)	Target Analytes	CRQL	Units
	N-Nitrosodiphenylamine	10	µg/L
	Pentachlorophenol	50	µg/L
	Phenanthrene	10	µg/L
	Phenol	10	µg/L
	2-Picoline	50	µg/L
	Pyrene	10	µg/L
	Pyridine	10	µg/L
	1,2,3,4-Tetrachlorobenzene	10	µg/L
	1,2,4,5-Tetrachlorobenzene	10	µg/L
	2,3,4,6-Tetrachlorophenol	50	µg/L
	2,4-Toluenediamine	50	µg/L
	1,2,4-Trichlorobenzene	10	µg/L
	2,4,5-Trichlorophenol	50	µg/L
	2,4,6-Trichlorophenol	20	µg/L
Total or Dissolved RCRA Metals	Arsenic	50	µg/L
(EPA 200.10, 200.12, 200.13)	Barium	50	µg/L
	Cadmium	1	µg/L
	Chromium	5	µg/L
	Lead	1	µg/L
	Selenium	2	µg/L
	Silver	1	µg/L
	Zinc	50	µg/L
(EPA 245.2)	Mercury	0.5	µg/L
TOC/DOC (EPA 415.1)	Total Organic Carbon/Dissolved Organic Carbon	0.5	mg/L
TSS (EPA 160.2)	Total Suspended Solids	5	5

Notes:
* = Laboratory reporting limit may not meet the project CRQL. Laboratory will report to the method detection limits with results qualified as estimated.
CRQL = Contract Required Quantitation Limit as specified in Technical Specifications for the Grand Calumet River Restoration Fund Council with the exception of TOC detection limits from Columbia Analytical Services.
mg/L = milligrams per liter
µg/L = micrograms per liter

Table 6-4. Required Containers, Preservatives, and Holding Times

Analysis Type	Matrix	Container Size	Holding Time[1]	Preservation
			14 days extraction/40 days analysis	Ice (4+/- 2°C)
SVOCs	Sediment	8 oz glass		Frozen (-18°C)
			14 days extraction/40 days analysis	Ice (4+/- 2°C)
PCBs	Sediment	8 oz glass		Frozen (-18°C)
			14 days extraction/40 days analysis	Ice (4+/- 2°C)
PCB Congeners	Sediment	8 oz glass	1 year until analysis	Frozen (-18°C)
			14 days extraction/40 days analysis	Ice (4+/- 2°C)
Pesticides	Sediment	8 oz glass	1 year until analysis	Frozen (-18°C)
			6 months/28 days*	Ice (4+/- 2°C)
RCRA Metals	Sediment	4 oz glass		Frozen (-18°C)
Oil and Grease	Sediment	4 oz glass	28 days	Ice (4+/- 2°C)
TOC	Sediment	4 oz glass	28 days	Ice (4+/- 2°C)
AVS-SEM	Sediment	4 oz glass	7 days**	Ice (4+/- 2°C)
Grain size	Sediment	16 oz glass	6 months	Ice (4+/- 2°C)
Atterberg Limits	Sediment	Inc.	NA	Ice (4+/- 2°C)
Specific Gravity	Sediment	Inc.	NA	Ice (4+/- 2°C)
Moisture Content/Bulk Density	Sediment	Inc.	NA	Ice (4+/- 2°C)
Laboratory UU Triaxial Shear	Sediment	Undisturbed Core Section	NA	Ice (4+/- 2°C)
Consolidation	Sediment	Undisturbed Core Section	NA	Ice (4+/- 2°C)
Direct Shear	Sediment	Undisturbed Core Section	NA	Ice (4+/- 2°C)
Dredge Elutriate Test	Sediment	1 liter	NA	Ice (4+/- 2°C)
Modified Elutriate Test	Sediment	1 liter	NA	Ice (4+/- 2°C)
Column Settling	Sediment	40 liters	NA	Ice (4+/- 2°C)
SVOCs	Water	One 1-liter amber glass	7 days extraction/40 days analysis	Ice (4+/- 2°C)
PCBs	Water	One 1-liter amber glass	7 days extraction/40 days analysis	Ice (4+/- 2°C)
Pesticides	Water	One 1-liter amber glass	7 days extraction/40 days analysis	Ice (4+/- 2°C)
RCRA Metals	Water	One 500-mL HDPE	6 months/28 days*	Ice (4+/- 2°C), HNO_3 pH<2
				Ice (4+/- 2°C), H_2SO_4
DOC	Water	One 250-mL HDPE	28 days	pH<2
TOC	Water	One 250-mL HDPE	28 days	Ice (4°C), H_2SO_4 pH<2
TSS	Water	One 1-liter HDPE	28 days	Ice (4+/- 2°C)

* Holding time for mercury is 28 days. Holding time for the other RCRA metals is 6 months.

** Holding time not specified – assumed to be same as sulfides. Note: All holding times are from the date of sampling. Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis without being qualified.

7. SUPPLIES AND CONSUMABLES

Supplies and consumables necessary for the field investigation will be obtained through appropriate commercial markets and shall meet any supply-specific requirements outlined in this QAPP. All supplies and consumables will be inspected by Foster Wheeler Environmental personnel (e.g., the FOL or the QA Manager) prior to use. Any supplies/consumables that do not meet requirements will be discarded or returned to the supplier.

Supply-specific requirements include the following:

- Sampling equipment shall be manufactured from the procedural-specific material
- Sample bottle containers will be provided by the subcontractor laboratory
- Certifications from the supplier of the "cleanliness" of the bottles must be provided to Foster Wheeler Environmental by the laboratory and retained in the project files

Supplies and consumables will be stored, as necessary, in a designated area on the site. The storage area shall be protected from adverse conditions (e.g., weather, heat, etc.) to protect the supplies/consumables from possible outside contamination and breakage.

8. INSTRUMENT CALIBRATION AND PREVENTIVE MAINTENANCE

This section describes the requirements for control, calibration, adjustment (if necessary) and preventive maintenance of instrumentation. Instruments shall be calibrated and adjusted (if warranted) at specified, predetermined intervals using known, recognized standards. All instruments shall be calibrated and maintained in accordance with manufacturer's instructions.

8.1 FIELD INSTRUMENTATION

8.1.1 Calibration

The FOL or his designee will be responsible for ensuring that instrumentation is of the proper range, type, and accuracy for the test being performed. The FOL should also verify that all of the equipment is calibrated at their required frequencies, according to their specific calibration protocols/procedures.

All field measurement instruments must be calibrated according to the manufacturer's instructions prior to the commencement of the day's activities. Exceptions to this requirement shall be permitted only for instruments that have fixed calibrations pre-set by the equipment manufacturer. Calibration information shall be documented on instrument calibration and maintenance log sheets or in a designated field logbook. Information to be recorded includes the date, the operator, and the calibration standards (concentration, manufacturer, lot number, expiration date, etc.). All project personnel using measuring equipment or instruments in the field shall be trained in the calibration and usage of the equipment, and are personally responsible for ensuring that the equipment has been properly calibrated prior to its use (see Section 12).

In addition, all field instruments must undergo response verification checks at the end of the day's activities and at any other time that the user suspects or detects anomalies in the data being generated. The checks consist of exposing the instrument to a known source of analyte (e.g., the calibration solution), and verifying a response. If an unacceptable instrument response is obtained during the check (i.e., not within specifications), the data shall be labeled suspect, the problem documented in the site logbook, and appropriate corrective action taken. See Section 13 of this plan for further information on corrective action procedures.

Any equipment found to be out of calibration, shall be re-calibrated. When instrumentation is found to be out of calibration or damaged, an evaluation shall be made to ascertain the validity of previous test results since the last calibration check. If it is necessary to ensure the acceptability of suspect items, the originally required tests shall be repeated (if possible) using properly

calibrated equipment. Any instrument consistently found to be out of calibration shall be repaired or replaced.

8.1.2 Maintenance

Field equipment shall be maintained at its proper functional status in accordance to manufacturer manual specifications. A check of the equipment shall be performed before field activities begin, and any potential spare parts (e.g., batteries, connectors, etc.) and maintenance tools will be brought on site to minimize equipment downtime during the field activities. Visual checks of the equipment will be conducted on a daily basis. Routine preventive maintenance shall be performed to assure proper operation of the equipment. Any maintenance performed on field equipment will be documented on instrument calibration and maintenance sheets or in the designated field logbook, and shall be undertaken only by personnel who have the appropriate skills and/or training in the type of maintenance required (see Section 12).

8.2 LABORATORY INSTRUMENTATION

8.2.1 Calibration

Personnel at the laboratory will be responsible for ensuring that analytical instrumentation are of the proper range, type, and accuracy for the test being performed, and that all of the equipment are calibrated at their required frequencies, according to specific laboratory SOPs.

Laboratory equipment shall be calibrated using certified/nationally recognized standards and according to the laboratory SOPs. In addition, these methods/procedures specify the appropriate operations to follow during calibration or when any instrument is found to be out of calibration. Information on and frequency for laboratory QC samples are presented in Section 9.2 and/or the specified laboratory SOPs.

8.2.2 Maintenance

The laboratory is responsible for the maintenance of their analytical equipment, in accordance with manufacturers' specifications. Analytical personnel will be responsible for ensuring that instrumentation is functioning properly and within specific guidelines/specifications prior to starting any analysis. Maintenance, performed by either laboratory personnel or the manufacturer's service personnel, will be conducted according to the manufacturer's recommendations and procedures.

9. SAMPLE QUALITY ASSURANCE/QUALITY CONTROL

This section discusses the types and quantities of QA/QC samples to be collected during implementation of the field programs. The site-specific number and type of QA/QC samples are discussed in Section 6.

9.1 FIELD QUALITY CONTROL SAMPLES

The subsections below present general information and guidance on field QC samples, including definition and frequency of QC blanks. Field QC samples will be labeled and shipped according to the procedures outlined in Section 5.

9.1.1 Field Sample Duplicates

Field sample duplicates will be analyzed by the analytical laboratory to evaluate the precision and reproducibility of the sampling procedures. Field duplicate samples will be collected at a rate of five percent of the total samples for each specific matrix for each type of analysis (i.e., one duplicate for up to every 20 samples). The duplicate samples will be collected from the same location and at the same time as the original environmental sample; however, the duplicate samples will be "coded" in such a manner that the laboratory will not be able to determine that the samples are field QC (i.e., "blind" duplicates). An explanation of the duplicate "coding" must be written in the field logbook. Preservation and analysis of duplicate samples will be identical to those for the environmental samples. Precision of field data will be evaluated based on the calculation of RPD between the original and duplicate samples.

9.1.2 Equipment Rinse Blanks

A rinse blank (rinsate) will be collected to evaluate the potential for contamination of environmental samples from inadequate decontamination of field equipment. Rinse blanks shall be collected by pouring contaminant-free deionized (DI) water over and/or through either decontaminated equipment (e.g., compositing equipment for sediment sampling) or disposable equipment (e.g., sampling utensils), and collecting the rinsate. Rinse blanks will be collected at a frequency of five percent of the total samples for each specific matrix for each type of analysis (i.e., one field blank for up to every 20 samples). Preservation and analysis of rinse blanks will be identical to analysis of the associated environmental samples and will follow the guidelines specified in Table 6-4.

9.2 LABORATORY QUALITY CONTROL SAMPLES

General information and guidance on laboratory QC samples is presented below. A summary of QC procedures, frequencies, criteria, and corrective actions for the samples, as determined by the laboratory SOPs (see Section 6), is provided in Table 9-1. Laboratory internal QC checks will, at a minimum, conform to EPA method-specific QC requirements.

9.2.1 Method Blanks

A method blank will be analyzed with every batch of samples to ensure that contamination has not occurred during the analytical process. These blank samples will consist of a portion of analyte-free solid that is processed through the entire sample procedure the same as an environmental sample. For this project, the laboratory must use either playground sand or sodium sulfate as the matrix for nonaqueous method blanks. These matrices will be subjected to all reagents, surrogates, internal standards, and method protocols to which the environmental samples are subjected.

9.2.2 Matrix Spikes/Matrix Spike Duplicates

Matrix spike/matrix spike duplicate (MS/MSD) samples will be used to assess precision and accuracy of the analytical methods. In this procedure, two aliquots of an actual field sample are "spiked" by the addition of a known amount of analyte(s) and these samples are then analyzed identically to the field samples. A comparison of the resulting concentration to the original sample concentration and among the two "spiked" sample concentrations provides information on the ability of the analytical procedure to generate an accurate and precise result from the sample. Samples will contain sufficient volume for MS/MSD sample analysis and will be analyzed at a frequency of 5 percent of the total samples.

9.2.3 Surrogate Compounds

Surrogates (also known as System Monitoring Compounds) are compounds of known concentrations added to every organic analysis sample for analytical chromatography methods at the beginning of the sample preparation to monitor the recovery in regard to sample preparation and analysis. Surrogate recoveries will be used to assess potential matrix interferences and potential problems resulting from sample extraction.

9.2.4 Internal Standards

Internal standards are used to provide instrument correction for variation in instrument performance and injection volumes for analytical chromatography methods. Internal standards also establish relative response factors for the analytes.

9.2.5 Laboratory Control Sample

Data from the Laboratory Control Sample (LCS) are used to monitor laboratory accuracy of a particular analytical method and to monitor laboratory performance. Generally, one LCS is analyzed per analytical batch. The LCS is an aliquot of reagent water spiked with the analytes as determined by the method. The LCS percent recoveries are used to evaluate the accuracy of the extraction and analysis procedures.

Table 9-1. Summary of Analytical QC Procedure Checks, Frequencies, Acceptance Criteria, and Corrective Actions for Laboratory Sample Analyses

Parameter	Method	QC Procedure	Frequency	Acceptance Criteria	Lab Corrective Action
Pesticides, PCBs, and PCB Congeners	SW846 8082 and SW846 8081A	ICV/CCV	ICV – following initial calibration CCV – every 20 samples	ICV - %RSD ≤ 20% CCV - ± 15% from value average response factors	ICV - Generate new calibration curve for that analyte CCV – Reanalyze CCV. If CCV fails again, generate a new calibration curve.
		Method Blank	1 per batch	no constituent > RL	Correct problem before resuming sample analysis
		MS/MSD	1 per ≤ 20 samples	0 - 30 RPD*	Follow method specifications
		MSB	1 per MS/MSD (≤ 20 samples), immediately following the MS/MSD	Compound and matrix specific	Follow method specifications
		QC check sample	At the end of each batch, or 1 per 20 samples, whichever is more frequent	Compound and matrix specific	Correct problem before resuming sample analysis
		LCS	1 per batch	50 – 150 % R*	Correct problem before resuming sample analysis
		Surrogate Compounds	all samples	compound and matrix specific*	Check calculations and instruments, re-extract and reanalyze affected samples. Allows 1 surrogate out.
SVOCs	SW846 8270C	ICV/CCV	ICV – following initial calibration CCV – every 12 hours	ICV - %RSD ≤ 30% CCV – per method SPCC/CCC requirements	ICV - Generate new calibration curve for that analyte CCV - Reanalyze CCV. If CCV fails again, generate a new calibration curve
		Method Blank	1 per ≤ 20 samples	No constituent > RL	Follow method specifications
		MS/MSD	1 per ≤ 20 samples	0 – 30 RPD*	Follow method specifications
		MSB	1 per MS/MSD (≤ 20 samples), immediately following the MS/MSD	compound and matrix specific	Follow method specifications
		LCS	1 per batch	50 – 150 % R*	Correct problem before resuming sample analysis
		QC check sample	At the end of each batch, or 1 per 20 samples, whichever is more frequent	compound and matrix specific	Correct problem before resuming sample analysis; reanalyze all samples preceding the failed QC check sample and following the last valid CCV

Table 9-1. Summary of Analytical QC Procedure Checks, Frequencies, Acceptance Criteria, and Corrective Actions for Laboratory Sample Analyses

Parameter	Method	QC Procedure	Frequency	Acceptance Criteria	Lab Corrective Action
		Surrogate Compounds	all samples	compound and matrix specific	Check calculations and instruments, re-extract and reanalyze affected samples if more than one surrogate is out of limits
RCRA Metals	SW846 6010B, SW846 7471A	ICV/CCV	ICV – following initial calibration	80 – 120 % R	ICV - Generate new calibration curve for that analyte
			CCV – every 10 samples		CCV - Reanalyze CCV. If CCV fails again, generate a new calibration curve
		ICB/CCB	Immediately following the ICV/CCV	no constituent > RL	If the sample concentration of the analyte is < 10 times the blank concentration and above the CRQL, the sample must be redigested and reanalyzed for that analyte
		Preparation Blank	1 per batch (≤ 20 samples)	no constituent > RL	Follow method specifications
		MS/MSD	1 per batch (≤ 20 samples)	< 20% RPD*	Follow method specifications
		LCS	1 per batch (≤ 20 samples), immediately following the MS/MSD	75 – 125 %R*	Correct the problem and reanalyze all samples prior to the failing LCS
		ICP Interference Check Sample (does not apply to method SW846 7471A)	Beginning and end of each analytical run	+/- 20% of true value	Correct the problem, recalibrate the instrument, reanalyze all samples following the last compliant ICP Interference Check Sample
		Laboratory Duplicate Sample	1 per batch	< 20% RPD for analyte concentrations ≥ 5 times the CRQL; +/- CRQL for analyte concentrations less than 5 times the CRQL	Flag all the data for the samples received associated with that duplicate sample with an "*"
Oil and Grease	SW846 9071B	Initial and continuing calibration	Follow method specifications	Follow method specifications	Follow method specifications
		Method Blank	Every 10 samples	No constituent > method MDL	Follow method specifications
		MS/MSD	1 per batch (≤ 20 samples)	< 20% RPD*	Follow method specifications

Table 9-1. Summary of Analytical QC Procedure Checks, Frequencies, Acceptance Criteria, and Corrective Actions for Laboratory Sample Analyses

Parameter	Method	QC Procedure	Frequency	Acceptance Criteria	Lab Corrective Action
		LCS	1 per batch (≤ 20 samples), immediately following the MS/MSD	Follow method specifications*	Correct the problem and reanalyze all samples prior to the failing LCS
TOC/DOC	EPA 415.1	Initial and continuing calibration	Follow method specifications	Follow method specifications	Follow method specifications
		Method Blank	Every 10 samples	No constituent > method MDL	Follow method specifications
		MS/MSD	1 per batch (≤ 20 samples)	< 20% RPD*	Follow method specifications
		LCS	1 per batch (≤ 20 samples), immediately following the MS/MSD	80 – 120 %R*	Follow method specifications
AVS-SEM	EPA Draft 1629	Initial and continuing calibration	Follow method specifications	Follow method specifications	Follow method specifications
		Method Blank	1 per batch	No constituent > method RL	Follow method specifications
		MS/MSD	1 per batch (≤ 20 samples)	< 20% RPD	Follow method specifications
		LCS	1 per batch (≤ 20 samples), immediately following the MS/MSD	Follow method specifications	Follow method specifications
TSS	EPA 160.2	Initial and continuing calibration	Follow method specifications	Follow method specifications	Follow method specifications
		Method Blank	Every 10 samples	No constituent > method MDL	Follow method specifications
		MS/MSD	1 per batch (≤ 20 samples)	< 20% RPD*	Follow method specifications
		LCS	1 per batch (≤ 20 samples), immediately following the MS/MSD	80 – 120 %R*	Follow method specifications

Table 9-1. Summary of Analytical QC Procedure Checks, Frequencies, Acceptance Criteria, and Corrective Actions for Laboratory Sample Analyses

Parameter	Method	QC Procedure	Frequency	Acceptance Criteria	Lab Corrective Action
Grain Size	ASTM D 422 with hydrometer	Laboratory Duplicate Sample	1 per batch	< 20% RPD for analyte concentrations ≥ 5 times the CRQL; +/- CRQL for analyte concentrations less than 5 times the CRQL	Flag all the data for the samples received associated with that duplicate sample with an "*"
Atterberg Limits	ASTM D 4318-95	Laboratory Duplicate Sample	1 per batch	< 20% RPD for analyte concentrations ≥ 5 times the CRQL; +/- CRQL for analyte concentrations less than 5 times the CRQL	Flag all the data for the samples received associated with that duplicate sample with an "*"
Specific Gravity	ASTM D 854-92	Laboratory Duplicate Sample	1 per batch	< 20% RPD for analyte concentrations ≥ 5 times the CRQL; +/- CRQL for analyte concentrations less than 5 times the CRQL	Flag all the data for the samples received associated with that duplicate sample with an "*"
Moisture Content/Bulk Density	ASTM D 2216	Laboratory Duplicate Sample	1 per batch	< 20% RPD	Flag all the data for the samples received associated with that duplicate sample with an "*"
Laboratory UU Triaxial Shear	ASTM D 2850	NA	NA	NA	NA
Consolidation	ASTM D 2435-90	NA	NA	NA	NA
Direct Shear	ASTM D 3080	NA	NA	NA	NA
Dredge Elutriate Test	DiGiano et al. 1995	NA	NA	NA	NA
Modified Elutriate Test	USEPA/USACE 1998	NA	NA	NA	NA
Column Settling	USEPA/USACE 1998	NA	NA	NA	NA

ASTM = American Society for Testing and Materials
ICV = Initial Calibration Verification
CCV = Continuing Calibration Verification
MS/MSD = matrix spike/matrix spike duplicate
MSB = matrix spike blank
QC = Quality Control
LCS = Laboratory Control Sample
* See Laboratory limits in Attachment 2

CRQL = Contract Required Quantitation Limit
RPD = relative percent difference
CCC = calibration check compound
SPCC = system performance check compounds
RCRA = Resource Conservation and Recovery Act
MDL = method detection limit

10. DATA MANAGEMENT

Standard methods and references will be used as guidelines for data handling, reduction, validation, and reporting. All data for the project will be compiled and summarized with an independent verification at each step in the process to prevent transcription/typographical errors. Any computerized entry of data will also undergo verification review.

10.1 DATA REDUCTION

10.1.1 Field Data Reduction

Field instrumentation data will be reported by site personnel in field logbooks and/or on field investigation forms associated with the sampling event.

10.1.2 Laboratory Data Reduction

The analytical laboratory will tabulate and compile analytical results and associated QA/QC information according to method procedures. All data generated by the laboratory will be reported in appropriate formats and concentration units consistent with standard EPA procedures and this project QAPP. Laboratory QA/QC information required by the method protocols will be compiled, including the application of data QA/QC qualifiers as appropriate. In addition, laboratory worksheets, laboratory notebooks, sample tracking system forms, chains-of-custody forms, instrument logs, and calibration records, as applicable, will be provided in the laboratory data packages to determine the validity of data. Specifics on internal laboratory data reduction protocols are identified in the laboratory's quality assurance plan or SOPs.

10.1.3 Project Data Reduction

Following receipt of the laboratory analytical results by Foster Wheeler Environmental, the data will be validated as indicated in Section 10.2. The results will be compiled in a relational database for evaluation and presentation in an appropriate tabular form. Where appropriate, the impacts of QA/QC qualifiers resulting from laboratory or external validation reviews will be assessed in terms of data usability. At this time, the QA/QC qualifiers will be added to the project database.

10.1.4 Non-Direct Measurements

If information necessary for the project has not been measured directly in the field, non-direct measurement data may be obtained from literature files, texts, computer databases, etc. References utilized will be acknowledged sources within the specific discipline. An explanation of the rationale behind using the reference and a description of any concern on using the reference data (e.g., uncertainty, conflicting literature, etc.) shall be documented. Non-direct measurement data, after usage, will be filed within the project files for the length of the project.

10.1.5 Data Usage

The data generated in the field, laboratory, and/or office will be used to satisfy the individual task requirements. The specific equations and the calculations that are used to reduce the data in the acceptable format will be described and documented, as appropriate.

10.2 DATA VALIDATION

Data validation and usability are evaluated to determine whether or not project data conform to specified criteria and satisfy project DQOs. This process involves evaluating the project data with respect to the DQOs and resolving any outstanding data issues to determine the certainty with which data may be used in making project decisions. Data not meeting the DQO criteria may be classified as screening (or characterization) data and used to provide additional information for the project, but it may not be used in the decision-making process.

Analytical data validation shall be completed on 100 percent of the samples. Validation will be performed by qualified third-party subcontractor in accordance with the National Functional Guidelines for Inorganic Data Review (EPA, 1994) and National Functional Guidelines for Organic Data Review (EPA, 1999). Analytical data validation will include a systematic review of the analytical data package for compliance with the established QC criteria. The validation will consider aspects such as proper laboratory sample handling, conformance to method requirements, acceptable QC sample results, and proper final data reporting. During data validation, any outstanding data issues will be resolved to determine the certainty with which data may be used in making project decisions. Results of the data review process will be used to determine whether to accept, reject, or qualify the analytical results.

The analytical laboratory will perform in-house analytical data reduction and data QA review prior to releasing the data to Foster Wheeler Environmental. The purpose of the review is to ensure that the analysis was performed correctly and that the results were reported correctly. The

laboratory review will consider data comparability, integrity, and attainment of QC criteria as outlined in laboratory SOPs, established in EPA methods, or described in this QAPP. Laboratory reviews are typically conducted at several levels within the laboratory. The initial review is the responsibility of the analyst generating the data. The section manager may conduct a second level review. Finally, the laboratory QA manager will complete a thorough audit of reports at a specified frequency and will review all final reports for consistency and clarity of presentation. The laboratory QA manager will decide whether any sample reanalysis is required and on the approach for any corrective actions. The laboratory QA manager is responsible for assessing data quality and documenting any data that are considered "preliminary" or "unacceptable" or that would caution the data user of possible unreliability.

Qualifiers (as applicable) will be added to the project database by manual computer entry. All keyed entries will be verified and signed off as checked by the QA Manager or his designee.

10.3 DATA REPORTING

10.3.1 Contents of Laboratory Data Reports

The results of the laboratory analyses will be reported to the Foster Wheeler Environmental PM in a hardcopy report and in an electronic format. The hardcopy report shall consist of a Contract Laboratory Program (CLP) type deliverable. The hardcopy laboratory report will contain information such as:

- Title and location of the project
- Project identification number
- Name of the report
- Date report was prepared
- Name, address and telephone number of the laboratory
- Case narrative (noting any problems encountered in receipt or during analysis of the samples, and the corrective actions utilized including telephone logs, etc.)
- Sample identification number
- Name and location of sample
- Type of sample (e.g., water, sediment)
- Analysis performed

- Parameter results
- Any special observations, circumstances, or comments that may be relevant for interpretation of the data
- Signature of laboratory manager

Each laboratory report will also include supporting documentation, such as copies of chromatograms, data system printouts, laboratory QC sample recoveries and RPDs, surrogate recoveries, data flags, instrument and extraction blank results, check standard recoveries, initial calibration data, internal sample tracking documentation, sample preparation and analysis logbooks, and standard preparation data, as appropriate. Each constituent tested will include the name of parameter, approved testing procedure references, results of analysis, and the units of the reported results. The sample data results shall also be submitted in the STL standard electronic data format within the project-specific turnaround time.

The electronic data report will be provided in Access and will include data in the following fields:

- Laboratory sample number
- Project sample identification
- Sample collection date
- Analytical method
- Analyte
- Flagging field associated with sample concentration
- Method detection limit
- Method reporting limit
- Sample-specific reporting limit
- Sample concentration
- Units
- Qualifier code
- Sample analysis date
- Sample matrix

10.3.2 Contents of Data Validation Reports

The analytical data in support of the WBGCR will be validated by Laboratory Data Consultants, Carlsbad, California. The data validation subcontractor will prepare a data validation report. The data validation report will provide a thorough evaluation of the analytical data and will determine whether or not the data meets the project-specific criteria for data quality. The report will include a list of samples associated with the report, a discussion of quality issues of concern, a summary of sample result qualifications due to validation, and the signature of the validator.

10.3.3 Contents of Management Reports

The Foster Wheeler Environmental PM will provide weekly progress updates to the GCRRF members by telephone. Following sampling activities, Foster Wheeler Environmental will provide to GCRFF reports summarizing all data collected in the field, followed by a report summarizing all sampling activities. Additional reports required for this project include a report containing the analytical results from sampling and a validation report.

11. PERFORMANCE AND SYSTEMS AUDITS

Assessment activities will be conducted throughout the project to ensure compliance with the QAPP. The Foster Wheeler Environmental PM and/or FOL will conduct a "readiness review" for field activities prior to the commencement of the investigation. Equipment and supplies will be inventoried, and field instrumentation will be checked to ensure that all are in working order. Any maintenance activities performed during the "readiness review" are to be documented on instrument maintenance sheets or in a designated field logbook. During the sampling activities, the FOL will be responsible for auditing field activities to ensure conformance to the FSAP. Auditing activities will include examination of field sampling records, field instrument operating records, sample collection, handling and transport in compliance with the established procedures, adherence to QA procedures, and appropriate chemical of concern procedures.

Nonconformances identified during audits will generate a nonconformance report or a need for corrective action. These issues will be addresses by the QA manager prior to continuing work. Audits will be conducted, as needed, based on the significance of work activities, level of quality required to meet project objectives, and status of nonconformances or corrective actions previously identified.

Internal laboratory audits will be conducted by the laboratory QA department in accordance with the laboratory's specific QAPP. The analytical laboratories used for this project will be assessed according to standard laboratory audit procedures and internal laboratory QA requirements. Internal systems and performance audits will be conducted by the analytical laboratories in accordance with the laboratory SOPs. These audits are typically conducted at several levels. From the laboratories, they shall cooperate with regulatory agency personnel with Agency-requested internal technical systems and/or performance audits. Surveillance of field program activities will be conducted by the PM and FOL. External laboratory audits may be conducted by the EPA or other oversight agencies at their discretion.

12. TRAINING OF PROJECT STAFF

Foster Wheeler Environmental will establish requirements for training and qualification of project personnel to ensure that they are capable of performing investigation activities. The Foster Wheeler Environmental QA Manager, in consultation with the Foster Wheeler Environmental PM, will establish and implement a program for the Foster Wheeler Environmental staff involved in the project, to ensure compliance with the FSAP, the QAPP, and the EHS Plan.

Performance-based testing will be provided to all appropriate personnel performing project activities. Foster Wheeler Environmental's performance-based testing involves the review of the personnel's work products by the Foster Wheeler Environmental PM, FOL, and/or QA Manager, until the monitored individual reaches the desired level of competence in performing his work tasks. Once a person exhibits the required degree of competence, unannounced periodic monitoring is performed to ensure this level is maintained.

12.1 PROJECT-SPECIFIC PERSONNEL TRAINING

Project staff shall receive general training on the project objectives, the DQOs for the site, the FSAP, the QAPP, and the EHS Plan.

Quality assurance training will cover, but not be solely limited to, the following:

- QAPP elements, including project-specific QA requirements
- Need for proper documentation and records maintenance
- Responsibilities of project personnel
- Handling and review of field, laboratory, and non-direct measurement data

Foster Wheeler Environmental will assure that all personnel performing site activities shall receive training on their respective tasks. In general, training shall be provided to accomplish the following:

- Initial proficiency
- Maintain proficiency
- Adapt to changes in technology, methods, or job responsibilities

The extent of training will be commensurate with the following objectives:

- Scope, complexity, and nature of the activity to be performed
- Prior education, experience, and proficiency of personnel

12.2 TRAINING RECORDS

Foster Wheeler Environmental will complete and maintain all training records in the project files. They will include the following, as appropriate:

- Attendance sheets
- Records of course content, including dates of training and the instructor name
- Training logs and curricula
- Personnel training record
- Formal qualification/certification records (as applicable)

13. CORRECTIVE ACTION

Review and implementation of systems and procedures may result in recommendations for corrective action. Any deviations from the specified procedures within approved project plans due to unexpected site-specific conditions shall warrant corrective action. All errors, deficiencies, or other problems shall be brought to the immediate attention of the Foster Wheeler Environmental PM, who in turn shall contact the Foster Wheeler Environmental QA Manager or his designee (if applicable).

Procedures have been established to ensure that conditions adverse to data quality are promptly investigated, evaluated, and corrected. The procedures for review and implementation of a corrective action include the following:

- Define the problem
- Investigate the cause of the problem
- Develop a corrective action to eliminate the problem, in consultation with the personnel who defined the problem and who will implement the change
- Complete the required form describing the change and its rationale (see below for form requirements)
- Obtain all required written approvals
- Implement the corrective action
- Verify that the change has eliminated the problem

If any problems occur with the laboratory or analyses, the laboratory must immediately notify the Foster Wheeler Environmental Program Chemist. Corrective actions must be documented on telephone contact log sheets, which shall become part of the written narrative of the final data report.

During the field investigation, all changes to the sampling program must be documented on a FCR form. FCRs shall be numbered serially, starting with the number "01." A copy of the FCR must be maintained at the site and in the project management files.

All corrective action documentation and FCRs shall include an explanation of the problem and a proposed solution. Each report must be approved by the necessary personnel (e.g., the Foster Wheeler Environmental PM, the GCRRF Project Manager) before implementation of the change occurs. At a minimum, copies of the approved FCR form will be distributed to the Foster

Wheeler Environmental PM, the FOL, the QA Manager (as applicable), and the project files. A typical distribution list is provided at the bottom of the form. The Foster Wheeler Environmental PM shall be responsible for the controlling, tracking, implementing, and distributing of all identified changes/forms.

14. REFERENCES

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ATTACHMENT 1
STL Laboratory
Quality Assurance Manual

LABORATORY QUALITY MANUAL

STL Chicago
2417 Bond Street
University Park, Illinois 60466-3182
(708) 534-5200

Approved by (Signature / Date):

Michael J. Healy / 9-4-02
Michael J. Healy
Laboratory Manager

Terese A. Preston 9/4/02
Terese A. Preston
Quality Assurance Manager

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Full Signature Approvals Are Kept on File
with STL's QA Standard Practice Records

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1.0 Introduction, Purpose, and Scope

1.1 STL Overview

STL Chicago (STL) is a part of Severn Trent Laboratories, a major group of U.S. based companies. The companies are owned by Severn Trent, plc, an international provider of water and wastewater services headquartered in Birmingham, UK.

STL is a full-service environmental laboratory that provides quality comprehensive and integrated professional analytical services effectively and efficiently. A broad range of environmental testing services are offered that span a variety of matrices including aqueous, saline, solid, tissue and drinking water.

Associated with this activity are services to assure client requirements are known, communicated and satisfactorily addressed, and a deliverables package presenting the analytical results. The laboratory provides expert personnel for supervision, technical consultation, and project review for effective planning and implementation of analytical assignments.

STL operates under the regulations and guidelines of the following federal programs:

- Air Force Center for Environmental Excellence (AFCEE)
- US Army Corp of Engineers, Hazardous, Toxic and Radioactive Waste (USACE HTRW)
- Clean Water Act (CWA)
- Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)
- Navy Facilities Engineering Service Center (NFESC)
- National Pollution, Discharge, and Elimination System (NPDES)
- Resource Conservation and Recovery Act (RCRA)
- Safe Drinking Water Act (SDWA)
- Toxic Substances Control Act (TSCA)

STL also provides services under various state and local municipal guidelines. A current table of analytical services, list of certifications and general service listing is presented on the MySTL webpage or available from the laboratory.

1.2 Quality Assurance Policy

It is STL's policy to:

- Provide high quality, consistent, and objective environmental testing services that meet all federal, state, and municipal regulatory requirements.
- Generate data that are scientifically sound, legally defensible, meet project objectives, and are appropriate for their intended use.
- Provide STL clients with the highest level of professionalism and the best service practices in the industry.
- Build continuous improvement mechanisms into all laboratory, administrative, and managerial activities.
- Maintain a working environment that fosters open communication with both clients and staff.

1.3 Management Commitment to Quality Assurance

STL management is committed to providing the highest quality data and the best service in the environmental testing industry. To ensure that the data produced and reported by STL meet the requirements of its clients and comply with the letter and spirit of municipal, state and federal regulations, STL maintains a quality system that is clear, effective, well communicated, and supported at all levels in the company.

Line organizations verify that specifications are achieved; QA organizations assist and provide oversight and verification of processes through planning, reviews, audits, and surveillances. The quality objectives are derived from this Laboratory Quality Manual (LQM), Standard Operating Procedures (SOPs) and Work Instructions.

STL Mission Statement

We enable our customers to create safe and environmentally favorable policies and practices, by leading the market in scientific and consulting services. We provide this support within a customer service framework that sets the standard to which others aspire. This is achieved by people whose professionalism and development is valued as the key to success and through continued investments in science and technology.

1.4 Purpose

The purpose of the LQM is to describe STL's Quality System and to outline how that system enables all employees to meet the Quality Assurance (QA) policy. This LQM also describes specific QA activities and requirements and prescribes their frequencies. Roles and responsibilities of management and laboratory staff in support of the Quality System are also defined in this LQM.

1.5 Scope

This LQM is specific to STL Chicago's quality systems and laboratory operation's. All other STL locations have LQMs under the Corporate Quality Management Plan (QMP) or the Corporate QMP itself.

The laboratory is committed to ensuring that resources are available and deployed to meet client expectations. This includes gathering project information prior to sample receipt to ensure client expectations will be met with respect to:

- Sampling containers
- Analytical methods employed
- Accuracy and precision
- Reporting limits
- Personnel qualifications, training, and experience
- Calibration and quality control measures employed
- Regulatory requirements
- Report contents
- Supporting documentation, records and evidence

- Validation of data

1.6 Servicing

Project Managers are the direct client contact and they ensure resources are available to meet project requirements. Although Project Managers do not have direct reports or staff in production, they coordinate opportunities and work with laboratory management and supervisory staff to ensure available resources are sufficient to perform work for the client's project. Project Managers provide a link between the client and laboratory resources.

The laboratory has established procedures for performing and verifying that client servicing meets requirements. Typical services provided are:

- Sample Containers/Supplies – *Container Management: Process Operation* (UCM-001)
- Project QAP preparation – *Project Planning Process* (UPM-003)
- Regulatory advisory functions – *Project Planning Process* (UPM-003)
- Consulting – *Project Planning Process* (UPM-003)

Regulatory and advisory functions are addressed under the same procedures used for project planning.

2.0 References

The following references were used in preparation of this document and as the basis of the STL Quality System:

EPA Guidance for Preparing Standard Operating Procedures (SOPs) for Quality Related Documents, EPA QA/G-6, US EPA, Office of Environmental Information, March 2001.

EPA Requirements for Quality Management Plans, EPA QA/R-2, US EPA, Office of Environmental Information, March 2001.

EPA Requirements for Quality Assurance Project Plans, EPA QA/R-5, US EPA, Office of Environmental Information, March 2001.

EPA Quality Manual for Environmental Programs, 5360 A1, US EPA Office of Research and Development, National Center for Environmental Research and Quality Assurance, Quality Assurance Division, May 2000.

General Requirements for the Competence of Testing and Calibration Laboratories, ISO/IEC 17025, December 1999.

Good Automated Laboratory Practices, EPA 2185, August 1995.

Quality Assurance Project Plan, HQ Air Force Center for Environmental Excellence, Version 3.1, August 2001.

National Environmental Laboratory Accreditation Conference, Constitution, Bylaws, and Standards, EPA 600/R-00/084, US EPA Office of Research and Development, June 2000.

Navy Installation Restoration Laboratory Quality Assurance Guide, Interim Guidance Document, Naval Facilities Engineering Service Center, February 1996.

Navy Installation Restoration Chemical Data Quality Manual, Navy IR CDQM, September 1999.

Quality Systems Manual for Environmental Laboratories, Department of Defense, Version 1, October 2000.

Shell for Analytical Chemistry Requirements, US Army Corps of Engineers, December 1998.

This LQM was written to comply with the National Environmental Laboratory Accreditation Conference (NELAC) standards. Refer to Table 1 for a cross-section comparison of this LQM to the NELAC standards.

Table 1.

Correlation of QAPP Sections with NELAC 5.5.2 Quality Manual Requirements

NELAC Chapter 5.5.2 Quality Manual	Laboratory Quality Manual Section
a. Quality policy statement, including objectives and commitments	1.2 Quality Assurance Policy 4.2.1 Objectives of the Quality System
b. Organization and management structure	4.1 Organization and Management
c. Relationship between management, technical operations, support services and the quality systems	4.1.2 Roles and Requirements 4.2 Quality System
d. Records retention procedures; document control procedures	4.3 Document Control 4.12.2 Record Retention
e. Job descriptions of key staff and references to job descriptions of other staff	4.1.2 Roles and Requirements
f. Identification of laboratory approved signatories	4.1 Organization and Management
g. Procedures for achieving traceability of measurements	5.5 Measurement Traceability
h. List of all test methods under which the laboratory performs its accredited testing	5.3.1 Method Selection
i. Mechanisms for assuring the laboratory reviews all new work to ensure that it has the appropriate facilities and resources before commencing such work	4.4.2 Project-Specific Quality Planning
j. Reference to the calibration and/or verification test procedures used	5.4.3 Equipment Verification and Calibration 5.3.6.2 Data Review
k. Procedures for handling submitted samples	4.7.1 Sample Acceptance Policy 5.7 Sample Handling, Transport and Storage
l. Reference to the major equipment and reference measurement standards used as well as the facilities and services used in conducting tests	1.6 Servicing 4.1.1 Laboratory Facilities 5.4.2 Equipment Maintenance 5.4.3 Equipment Verification and Calibration
m. Reference to procedures for calibration, verification and maintenance of equipment	5.4.2 Equipment Maintenance 5.4.3 Equipment Verification and Calibration

Table 1.

Correlation of QAPP Sections with NELAC 5.5.2 Quality Manual Requirements

NELAC Chapter 5.5.2 Quality Manual	Laboratory Quality Manual Section
n. Reference to verification practices including inter-laboratory comparisons, proficiency testing programs, use of reference materials and internal QC schemes	5.8.1 Proficiency Testing 5.8.2 Control Samples
o. Procedures for feedback and corrective action whenever testing discrepancies are detected, or departures from documented procedures occur	4.9 Control of Non-Conformances 4.10 Corrective Action 4.11 Preventive Action 5.8.6 Permitting Departures from Documented Procedures
p. Laboratory management arrangements for exceptionally permitting departures from documented policies and procedures	4.4.2 Project-Specific Quality Planning 5.8.6 Permitting Departures from Documented Procedures
q. Procedures for dealing with complaints	4.8 Complaints
r. Procedures for protecting confidentiality and proprietary rights	4.7.2 Client Confidentiality and Proprietary Rights
s. Procedures for audits and data review	4.13 Internal Audits 4.14 External Audits 5.3.6 Data Reduction and Review
t. Process/procedures for establishing that personnel are adequately experienced in duties they are expected to carry out and are receiving any needed training	5.1.2 Training
u. Ethics policy statement developed by the laboratory and training personnel in their ethical & legal responsibilities	5.1.3 Ethics Policy
v. Reference to procedures for reporting analytical results	5.3.6 Data Reduction and Review 5.9 Project Reports
w. Table of contents, listing reference, glossaries and appendices	TOC Table of Contents Appendix List of Cited SOPs and Work Instructions

3.0 Terms and Definitions

Accuracy: The degree of agreement between a measurement and true or expected value, or between the average of a number of measurements and the true or expected value.

Audit: A systematic evaluation to determine the conformance to specifications of an operational function or activity.

Batch: Environmental samples, which are prepared and/or analyzed together with the same process, using the same lot(s) of reagents. A preparation batch is composed of 1 to 20 environmental samples of a similar matrix, meeting the above mentioned criteria. Where no preparation method exists (e.g., volatile organics, water), the batch is defined as environmental samples that are analyzed together with the same process and personnel, using the same lots of reagents, not to exceed 20 environmental samples. An analytical batch is composed of prepared environmental samples, extracts, digestates or

concentrates that are analyzed together as a group. An analytical batch can include prepared samples originating from various environmental matrices and can exceed 20 samples.

Chain of Custody (COC): A system of documentation demonstrating the physical possession and traceability of samples.

Comprehensive Environmental Response, Compensation and Liability Act (CERCLA/Superfund): Legislation (42 U.S.C. 9601-9675 et seq., as amended by the Superfund Amendments and reauthorization Act of 1986 (SARA), 42 U.S.C. 9601et seq.

Compromised Sample: A sample received in a condition that jeopardizes the integrity of the results. See Section 4.7.1 for a description of these conditions.

Confidential Business Information (CBI): Information that an organization designates as having the potential of providing a competitor with inappropriate insight into its management, operation or products.

Confirmation: Verification of the presence of a component using an additional analytical technique. These may include second column confirmation, alternate wavelength, derivatization, mass spectral interpretation, alternative detectors, or additional cleanup procedures.

Corrective Action: Action taken to eliminate the causes of an existing non-conformance, defect or other undesirable situation in order to prevent recurrence.

Data Audit: A qualitative and quantitative evaluation of the documentation and procedures associated with environmental measurements to verify that the resulting data are of acceptable quality.

Demonstration of Capability (DOC): Procedure to establish the ability to generate acceptable accuracy and precision.

Equipment Blank (EB): A portion of the final rinse water used after decontamination of field equipment; also referred to as Rinsate Blank and Equipment Rinsate.

Document Control: The act of ensuring that documents (electronic or hardcopy and revisions thereto) are proposed, reviewed for accuracy, approved for release by authorized personnel, distributed properly and controlled to ensure use of the correct version at the location where the prescribed activity is performed.

Federal Water Pollution Control Act (Clean Water Act, CWA): Legislation under 33 U.S.C. 1251 et seq., Public Law 92-50086 Stat. 816.

Field Blank (FB): A blank matrix brought to the field and exposed to field environmental conditions.

Field Duplicate: Duplicate field-collected sample.

Field of Testing: A field of testing is based on NELAC's categorization of accreditation based on program, matrix, analyte.

Good Laboratory Practices (GLP): Formal regulations for performing basic laboratory operations outlined in 40 CFR Part 160 and 40 CFR Part 729 and required for activities performed under FIFRA and TSCA.

Holding Time: The maximum time that a sample may be held before preparation and/or analysis as promulgated by regulation or as specified in a test method.

Instrument Blank: A blank matrix that is the same as the processed sample matrix (e.g. extract, digestate, condensate) and introduced onto the instrument for analysis.

Internal Chain of Custody: An unbroken trail of accountability that ensures the physical security of samples, data and records. Internal Chain of Custody refers to additional documentation procedures implemented within the laboratory that includes special sample storage requirements, and documentation of all signatures and/or initials, dates, and times of personnel handling specific samples or sample aliquots.

Instrument Detection Limit (IDL): The minimum amount of a substance that can be measured with a specified degree of confidence that the amount is greater than zero using a specific instrument. The IDL is associated with the instrumental portion of a specific method only, and sample preparation steps are not considered in its derivation. The IDL is a statistical estimation at a specified confidence interval of the concentration at which the relative uncertainty is ±100%. The IDL represents a range where qualitative detection occurs on a specific instrument. Quantitative results are not produced in this range.

Laboratory Control Sample (LCS): A blank matrix spiked with a known amount of analyte(s), processed simultaneously with, and under the same conditions as, samples through all steps of the analytical procedure.

Laboratory Quality Manual (LQM): A document stating the quality policy, quality system and quality practices of the laboratory. The LQM may include by reference other documentation relating to the laboratory's quality system.

Limit of Detection (LOD): The minimum amount of a substance that an analytical process can reliably detect.

Matrix: The substrate of a test sample. Common matrix descriptions are defined in Table 2.

Table 2. Matrix Descriptions

Matrix	Description
Aqueous	Aqueous sample excluded from the definition of Drinking Water or Saline/Estuarine source. Includes surface water, groundwater, effluents, leachates and wastewaters.
Drinking Water	Aqueous sample that has been designated a potable water source.
Saline	Aqueous sample from an ocean or estuary, or other salt-water source such as the Great Salt Lake.
Liquid	Liquid with <15% settleable solids.
Solid	Soil, sediment, sludge, ash, paint chips, filters, wipes or other matrices with ≥15% settleable solids.

Matrix	Description
Waste	A product or by-product of an industrial process that results in a matrix not previously defined (i.e., drum liquid or oils).
Tissue	Sample of a biological origin such as fish tissue, shellfish, or plant material. Such samples shall be grouped according to origin.

Matrix Duplicate (MD): Duplicate aliquot of a sample processed and analyzed independently; under the same laboratory conditions; also referred to as Sample Duplicate; Laboratory Duplicate.

Matrix Spike (MS): Field sample to which a known amount of target analyte(s) is added.

Matrix Spike Duplicate (MSD): A replicate matrix spike.

Method Blank (MB): A blank matrix processed simultaneously with, and under the same conditions as, samples through all steps of the analytical procedure.

Method Detection Limit (MDL): The minimum amount of a substance that can be measured with a specified degree of confidence that the amount is greater than zero using a specific measurement system. The MDL is a statistical estimation at a specified confidence interval of the concentration at which the relative uncertainty is ±100%. The MDL represents a range where qualitative detection occurs using a specific method. Quantitative results are not produced in this range.

Non-conformance: An indication, judgment, or state of not having met the requirements of the relevant specifications, contract, or regulation.

Precision: An estimate of variability. It is an estimate of agreement among individual measurements of the same physical or chemical property, under prescribed similar conditions.

Preservation: Refrigeration and/or reagents added at the time of sample collection to maintain the chemical, physical and/or biological integrity of the sample.

Proficiency Testing: Determination of the laboratory calibration or testing performance by means of inter-laboratory comparisons.

Proficiency Test (PT) Sample: A sample, the composition of which is unknown to the analyst, that is provided to test whether the analyst/laboratory can produce analytical results within specified performance limits. Also referred to as Performance Evaluation (PE) Sample.

Proprietary: Belonging to a private person or company.

Quality Assurance (QA): An integrated system of activities involving planning, quality control, quality assessment, reporting and quality improvement to ensure that a product or service meets defined standards of quality with a stated level of confidence.

Quality Assurance (Project) Plan (QAPP): A formal document describing the detailed quality control procedures by which the quality requirements defined for the data and decisions pertaining to a specific project are to be achieved.

Quality Control (QC): The overall system of technical activities, the purpose of which is to measure and control the quality of a product or service.

Quality Control Sample: A control sample, generated at the laboratory or in the field, or obtained from an independent source, used to monitor a specific element in the sampling and/or testing process.

Quality Management Plan (QMP): A formal document describing the management policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an agency, organization or laboratory to ensure the quality of its product and the utility of the product to its users.

Quality System: A structured and documented management system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an organization for ensuring quality in its work processes, products (items), and services. The quality system provides the framework for planning, implementing, and assessing work performed by the organization and for carrying out required QA/QC.

Quantitation Limit (QL): The minimum amount of a substance that can be quantitatively measured with a specified degree of confidence and within the accuracy and precision guidelines of a specific measurement system. The QL can be based on the MDL, and is generally calculated as 3-5 times the MDL, however, there are analytical techniques and methods where this relationship is not applicable. Also referred to as Practical Quantitation Level (PQL), Estimated Quantitation Level (EQL), Limit of Quantitation (LOQ).

Raw Data: Any original information from a measurement activity or study recorded in laboratory notebooks, worksheets, records, memoranda, notes, or exact copies thereof and that are necessary for the reconstruction and evaluation of the report of the activity or study. Raw data may include photography, microfilm or microfiche copies, computer printouts, magnetic/optical media, including dictated observations, and recorded data from automated instruments. Reports specifying inclusion of "raw data" do not need all of the above included, but sufficient information to create the reported data.

Record Retention: The systematic collection, indexing and storing of documented information under secure conditions.

Reference Standard: A standard, generally of the highest metrological quality available at a given location, from which measurements made at that location are derived.

Reporting Limit (RL): The level to which data is reported for a specific test method and/or sample. The RL is generally related to the QL. The RL must be minimally at or above the MDL.

Resource Conservation and Recovery Act (RCRA): Legislation under 42 USC 321 et seq. (1976).

Safe Drinking Water Act (SDWA): Legislation under 42 USC 300f et seq. (1974), (Public Law 93-523).

Sampling and Analysis Plan (SAP): A formal document describing the detailed sampling and analysis procedures for a specific project.

Selectivity: The capability of a measurement system to respond to a target substance or constituent.

Sensitivity: The difference in the amount or concentration of a substance that corresponds to the smallest difference in a response in a measurement system using a certain probability level.

Spike: A known amount of an analyte added to a blank, sample or sub-sample.

Standard Operating Procedure (SOP): A written document which details the method of an operation, analysis or action whose techniques and procedures are thoroughly prescribed and which is accepted as the method for performing certain routine or repetitive tasks.

Storage Blank: A blank matrix stored (2-weeks) with field samples of a similar matrix (volatiles only) that measures storage contribution to any source of contamination. OR A blank matrix stored with field samples of a similar matrix.

Systems Audit: A thorough, systematic, on-site, qualitative review of the facilities, equipment, personnel, training, procedures, record keeping, data validation, data management, and reporting aspects of a total measurement system.

Test Method: Defined technical procedure for performing a test.

Toxic Substances Control Act (TSCA): Legislation under 15 USC 2601 et seq., (1976).

Traceability: The property of a result of a measurement that can be related to appropriate international or national standards through an unbroken chain of comparisons.

Trip Blank (TB): A blank matrix placed in a sealed container at the laboratory that is shipped, held unopened in the field, and returned to the laboratory in the shipping container with the field samples.

Verification: Confirmation by examination and provision of evidence against specified requirements.

4.0 Management Requirements

The organizational chart of STL is presented in Figure 1. Corporate employees are located at various STL facilities as outlined in the organizational structure. The organizational chart of STL Chicago is presented in Figure 2.

4.1 Organization and Management

The Laboratory Manager and Quality Manager are responsible and have the signature authority for approving and implementing this plan. Additional signatory authorities for the approval of work and release of reports are defined in the *Signature Authority* SOP (UQA-030).

Figure 1. STL Organization Chart

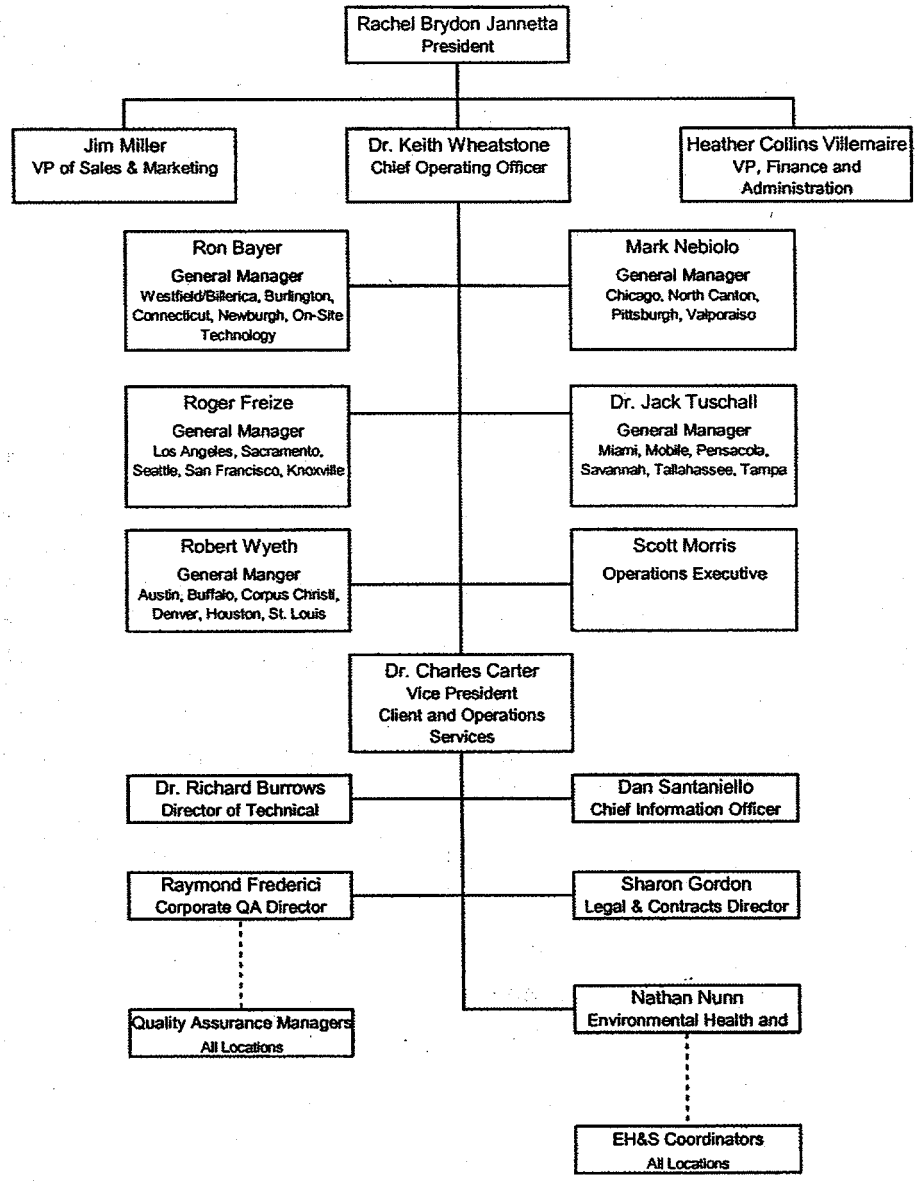
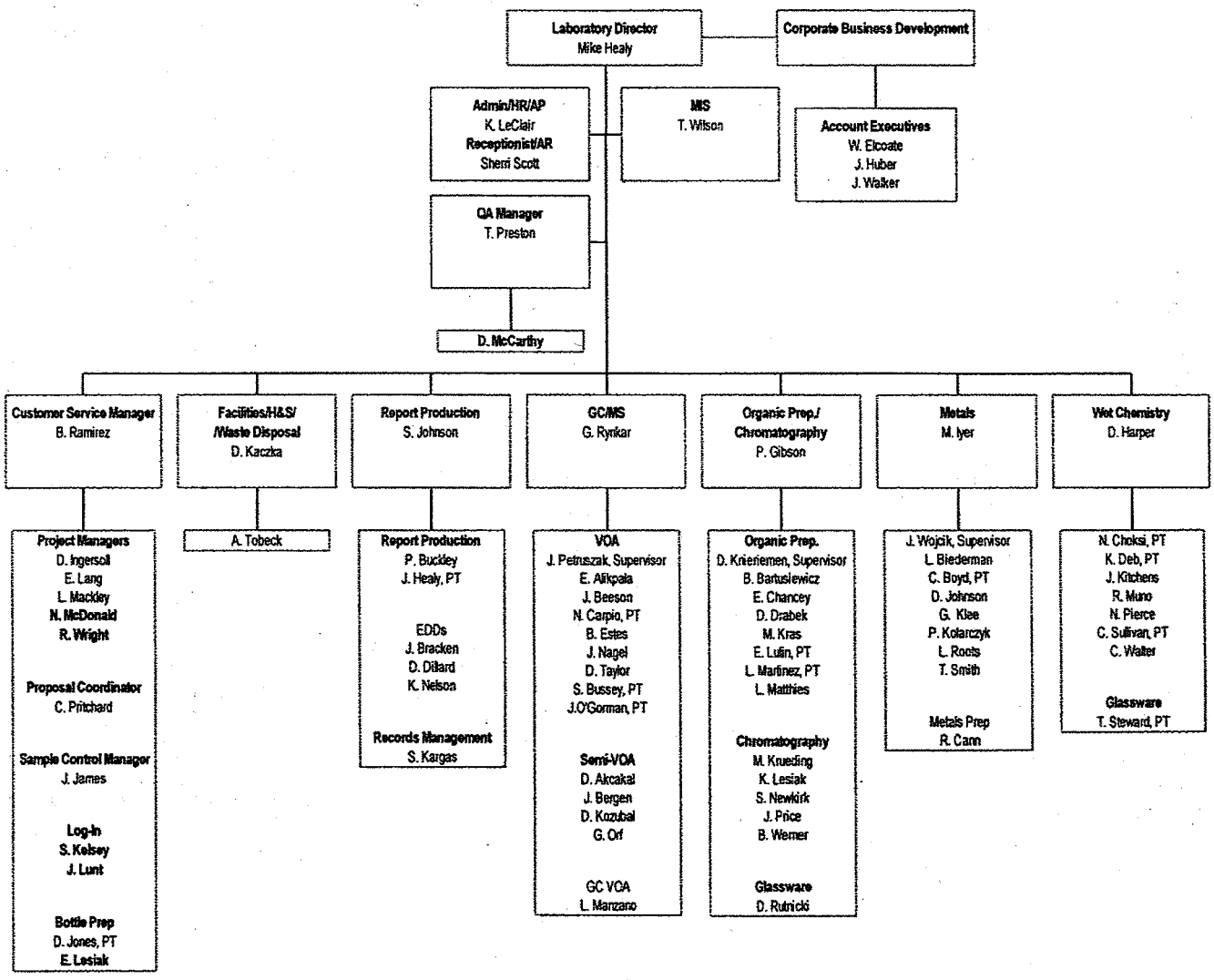


Figure 2. STL Chicago Organizational Chart



4.1.1 Laboratory Facilities

The laboratory is located in University Park, IL, which is approximately 30 miles south of Chicago, and is staffed by 82 professionals. The laboratory is comprised of 51,000 square feet of state-of-the-art commercial laboratory and office space and houses both inorganic and organic operations. The facility is divided into separate work areas to facilitate sample throughput. These areas include the following:

- Sample receipt and refrigerated storage
- Organic sample preparation
- Glassware preparation
- Metals digestion
- Wet chemistry laboratory
- Instrumentation laboratories

The main instrumentation laboratory is equipped with state-of-the-art instrumentation and sufficient duplicate equipment to provide back-up service for most major systems. A listing of laboratory equipment and instrumentation is referenced as Work Instruction No. CHI-22-09-103. Table 3 is a summary of the major laboratory instruments.

Table 3. Major Equipment List

GC	GC/MS	AA	ICP	CVAA	HPLC	AutoAnalyzer	IC	TOC	TOX
18	13	4	3	2	6	2	2	2	2

Each of these areas has separate heating, ventilation, and air conditioning systems. Non-destructive gas chromatographic detectors, and GC/MS rotary pumps are vented out of the instrumentation through charcoal filters.

4.1.2 Roles and Responsibilities

The specific duties and responsibilities of the Laboratory Manager, Quality Assurance Manager, Project Managers, Technical Managers, Sample Management Coordination, Data Management Section Manager, Quality Assurance Specialist, Health and Safety Coordinator/Waste Management, Information Technology Manager, and Chemists/Technicians are as follows.

In the absence of any one individual, the staff or assistant within each department is professionally skilled in the ability to administer the function of the administrator or support personnel. This will allow for the continuance of the day-to-day operations of the laboratory.

4.1.2.1 Laboratory Manager

The ultimate responsibility for the generation of reliable laboratory data rests with the Laboratory Manager, who is accountable to his General Manager and oversees the daily operations of the laboratory. The Laboratory Manager's responsibilities include allocation of personnel and resources, setting goals and objectives for both the business and employees, achieving the financial, business and quality objectives of STL. Furthermore, to see that all tasks performed in the laboratory are

conducted according to the requirements of this LQM, the Project Technical Profile and/or the appropriate QAPP; and to assure that the quality of service provided complies with the project's requirements.

The Laboratory Manager has the authority to effect those policies and procedures to ensure that only data of the highest level of excellence are produced. As such, the Laboratory Manager supports a QA Section which has responsibilities independent from sampling and analysis.

The Laboratory Manager, with the assistance of the Quality Assurance Manager, has the overall responsibility for establishing policies that ensure the quality of analytical services meet our clients expectations. These policies are defined in this LQM.

4.1.2.2 Quality Assurance Manager

The Quality Assurance (QA) Manager has the full-time responsibility to evaluate the adherence to policies and to assure that systems are in place to produce the level of quality defined in this LQM. The QA Manager is responsible for the approval of IDL/MDL studies, method validation studies, data package inspections; and LIMS system method development, validation and maintenance. In addition, the QA Manager may assist in the preparation, compilation, and submittal of quality assurance plans; reviews program plans for consistency with organizational and contractual requirements and advises appropriate personnel of deficiencies. The QA Manager is assisted by a QA Specialist that maintains QA records, certifications and accreditations, initiates and oversees both internal and external audits and corrective action procedures, manages the laboratory's PT Program, and maintains documentation of training.

The QA Manager shall have the final authority to accept or reject data, and to stop work in progress in the event that procedures or practices compromise the validity and integrity of analytical data. The QA Manager is available to any employee at the facility to resolve data quality or ethical issues. The QA Manager shall be independent of laboratory operations and has an indirect reporting relationship to the QA Director.

4.1.2.3 Project Managers

The laboratory recognizes the importance of efficient project management. The laboratory Project Managers (PM) are responsible for preparing the Project Technical Profile which summarizes QA/QC requirements for the project, maintaining the laboratory schedule, ensuring that technical requirements are understood by the laboratory, and advising the Laboratory, QA and Technical Managers of all variances. The laboratory Project Manager will provide technical guidance and the necessary laboratory-related information to the preparer of project-specific QAPPs and provide peer review of the final document to ensure accuracy of the laboratory information.

4.1.2.4 Technical Managers

The Technical Managers are the Laboratory Manager, laboratory Section Managers and the QA Manager. They are as follows:

- Michael J. Healy, Laboratory Manager, BS Environmental Biology,
  19 years laboratory experience.

- Terese A. Preston, Quality Assurance Manager, BA Biology, 18 years laboratory experience.
- Diane L. Harper, Inorganics Section Manager, MA Biology, 27 years laboratory experience.
- Mani S. Iyer, Metals Section Manager, BA Chemistry, 30 years laboratory experience.
- Patti J. Gibson, Chromatography/Organic Extractions Section Manager, BS Biology, 13 years laboratory experience.
- Gary L. Rynkar, GC/MS Section Manager, BS Environmental Biology, 13 years laboratory experience.

All of these managers report to the Laboratory Manager and serve as the technical experts on assigned projects, provide technical liaison, assist in resolving any technical issues within the area of their expertise; and implement established policies and procedures to assist the Laboratory Manager in achieving section goals. The Technical Managers are responsible for ensuring that their personnel are adequately trained to perform analyses; that equipment and instrumentation under their control is calibrated and functioning properly; that system and performance audits are performed on an as-needed basis; provide input and review in the development and implementation of project-specific QA/QC requirements; and for providing the critical review of proposal and project work for programs as directed by the Laboratory Manager. The Technical Managers coordinate these activities with the project management and quality assurance sections.

4.1.2.5 Sample Management Coordination

The Project Manager is designated as the Sample Management Coordination for any work subcontracted under their management. The Project Manager verifies each subcontracting request to ensure that special client restrictions are not jeopardized (e.g., samples must be analyzed by the receiving affiliated or network laboratory and must maintain specific certification(s)). The Project Manager is also responsible for verifying the credentials; establishing the service agreement; ensuring data review; and invoicing of all laboratory subcontractors. The Project Manager discusses any deficiencies or anomalies with the subcontractor prior to reporting any data to the client. The Project Manager processes and functions are further defined in the *Sample Management* SOP (USM-001).

4.1.2.6 Data Management Section Manager

The Data Management Section Manager is responsible for coordinating receipt of all data from the various service groups within the laboratory, reviewing data for compliance to laboratory QC criteria and/or criteria in the Project Technical Profile, and ensuring that data are reported in a timely manner and in the proper format.

4.1.2.7 Quality Assurance Specialist

The QA Specialist is responsible for conducting and evaluating results from system audits; the preparation of SOPs and QA documentation, reviews program plans for consistency with organizational and contractual requirements and will advise appropriate personnel. The QA Specialist also:

- Preparation, compilation, submittal and review of Quality Assurance Plans,

- Performs annual internal audits,
- Manages the performance testing (PT) studies and personnel training records,
- Manages document control,
- Assists the Project Management Group, and
- Manages certifications and accreditations.

4.1.2.8 Health and Safety Coordinator / Waste Management

The Health and Safety Coordinator is responsible for the safety and well-being of all employees while at the laboratory. This includes, but is not limited to, administering the Corporate Safety Manual that complies with federal regulations, MSDS training and review, conducting laboratory safety orientation and tours for all new employees, providing instructions on safety equipment, cleaning up laboratory spills, and instructing personnel of laboratory procedures for emergency situations. The Health and Safety Coordinator is on-call 24-hours a day, 7-days a week for all laboratory situations.

The Health and Safety Coordinator responsibilities additionally include waste management of laboratory generated hazardous waste in accordance with appropriate regulations. This includes maintenance of required documentation, such as waste manifests, segregation of waste in accordance with requirements, and training of personnel in proper segregation of waste.

4.1.2.9 Information Technology Manager

The overall role of the Information Technology (IT) Manager is to enhance laboratory productivity through improved information access, flow, and security. For information to be of greatest value, it must be readily accessible and reliable. It is the responsibility of the IT Manager to provide software tools that allow quick and user friendly access to that information, while at the same time controlling access to that information to those that have the need and proper authority.

Information flow can be enhanced through automation. Automation is the minimization of human intervention in a process. Reduction in human intervention can result in significant error reductions and time savings. The IT Manager assists the laboratory in automation by providing hardware and software solutions to help minimize human intervention in data collection, processing, and storage.

The IT Manager is responsible for providing data security by controlling access, as mentioned above, and for providing for disaster recovery. Data stored on the central Laboratory Information Management System (LIMS, a.k.a., LabNet) is the direct responsibility of the IT Manager. No fewer than two copies of all data should exist at any time so that lost or destroyed data can always be retrieved from an alternate source. These copies may consist of data within the system and on magnetic tape in the case of live data, or two copies on magnetic tape for archived data. Data stored electronically in other departments is the direct responsibility of those departments. However, the IT Manager is responsible for providing procedures and training to all laboratory operations, as appropriate, to assist in making backup copies of local data within the respective operating unit.

STL has established procedures for IT management:

- *Computer System Account and Naming Policy* – P-I-003
- *Password Policy* – P-I-004
- *Software Licensing* – P-I-005
- *Virus Protection Policy* – P-I-006

4.1.2.10 Chemists / Technicians

Any effective laboratory quality assurance/quality control program depends on the entire organization, including management and every individual on the laboratory staff. The initial review for acceptability of analytical results rests with the analysts conducting the various tests. Observations made during the performance of an analytical method may indicate that the analytical system is not in control. Analysts must use quality control indicators to assure that the method is in-control before reporting results.

4.2 Quality System

Organizational support for implementing the quality system and achieving the quality objectives is derived from this LQM, SOPs and Work Instructions. Within these documents, management with executive responsibilities ensures that the quality policy is understood, implemented, and maintained at all levels of the organization. The development and implementation of appropriate accountabilities, duties, and authority by organizational positions are clearly delineated. Line organizations achieve and verify that specifications are achieved; QA organizations assist and provide oversight and verification of processes through planning, reviews, audits, and surveillances. Top management leadership, support and direction ensures that the policies and procedures are appropriately implemented.

4.2.1 Objectives of the Quality System

The goal of the Quality System is to ensure that business operations are conducted with the highest standards of professionalism in the industry.

To achieve this goal, it is necessary to provide our clients with not only scientifically sound, well documented, and regulatory compliant data, but also to ensure that we provide the highest quality service available in the industry. A well-structured and well-communicated Quality System is essential in meeting this goal. The laboratory's Quality System is designed to minimize systematic error, encourage constructive, documented problem solving, and provide a framework for continuous improvement within the organization.

As stated in Section 1.3, this LQM, Work Instructions and the SOPs themselves are the basis and outline for our Quality System and contains general guidelines under which the laboratory conducts our operations. In addition, other documents may be used by the laboratory to clarify compliance with quality system or other client requirements. As you read this LQM, you will note SOP or Work Instruction numbers in parenthetic text. These numbers refer to the laboratory procedure(s) associated with the subject item. A table listing these quality system policies and procedures is appended to this LQM.

The QA Manager and QA Specialist are responsible for implementing and monitoring the Quality System. The QA Manager reports to the Laboratory Manager on the performance of the quality system for review and continuous improvement. The QA Manager has sufficient authority, access to work areas, and organizational freedom (including sufficient independence from cost and schedule considerations) to:

- Initiate action to prevent the occurrence of any nonconformities related to product, process and quality system,
- Identify and record any problems affecting the product, process and quality system,
- Initiate, recommend, or provide solutions to problems through designated channels,
- Verify implementation of solutions, and
- Assure that further work is stopped or controlled until proper resolution of a non-conformance, deficiency, or unsatisfactory condition has occurred and the deficiency or unsatisfactory condition has been corrected.

The QA Manager reports where appropriate action can be affected. However, should a situation arise where acceptable resolution of identified problems cannot be agreed upon at the laboratory level, direct access to STL's Corporate Quality Director is available. This provides laboratory QA personnel non-laboratory management support, if needed, to ensure that QA policies and procedures are enforced.

The QA Manager conducts annual LQM training for all laboratory and administrative personnel to ensure their familiarity with the quality documentation and the implementation of the policies and procedures in their work.

4.3 Document Control

The laboratory maintains procedures to control documents and analytical data. Since intensive data is generated and this is our primary product, document control is inherently segregated from data control, as described further in Sections 4.3.1 and 4.3.2.

4.3.1 Document Control Procedure

Security and control of documents are necessary to ensure that confidential information is not distributed and that all current copies of a given document are from the latest applicable revision (*Document Control*; UQA-006). Unambiguous identification of a controlled document is maintained by identification of the following items in the document header: Document Number, Revision Number, Effective Date, and Number of Pages. Document control may be achieved by either electronic or hardcopy distribution.

Controlled documents are authorized by the QA Department and are marked as either "Controlled' or "Uncontrolled" and records of their distribution are kept by the QA Department. Controlled status is defined as the continuous distribution of document updates. Uncontrolled status is defined as the single distribution of the current SOP. Document updates are not distributed to uncontrolled status holders. For tracking purposes, a control copy number is assigned to documents distributed with a controlled status. All copy numbers are written in red ink or type to easily identify the SOP as a controlled copy.

4.3.1.1 Document Revision

Changes to documents occur when a procedural change warrants a revision of the document. When an approved revision of a controlled document is ready for distribution, obsolete copies of the document are replaced with the current version of the document. The previous revision of the

controlled document is stamped "ARCHIVED COPY" and are stored by the QA Specialist in secured cabinets. Only the most current revision is maintained electronically.

SOPs are updated on a 12-18 month basis, which is tracked by an established review schedule (*Approved SOP Listing*; CHI-22-09-SOP List). These reviews are conducted by the writer/reviewer and/or QA Manager or Specialist, the department manager and the Health and Safety Coordinator, all of whom provide the approval signature for each SOP.

4.3.2 Data Control

All raw data, such as bound logbooks, instrument printouts, magnetic tapes, electronic data, as well as final reports, are retained for a minimum period of 5 years. Such data may be maintained longer, as defined by client and project requirements. Specifics on the procedure of archiving records and client or project specific requirements is contained in the *Record Retention and Purging* SOP (UDM-002).

Raw data and reports are documented and stored in a manner which are easily retrievable. The procedure for maintaining raw data records is briefly described below:

- Instrument print-outs for conventional inorganic parameters are filed by LabNet Batch Number. Inorganic Metals are filed by Instrument and Filename. Generally, current year and previous year documents are kept on file in the laboratory sections.
- All raw data, for example, instrument print-outs and logbooks, are maintained in an on-site and secured storage area.
- The computer information is backed up on tape daily, and stored in a secured and temperature/humidity controlled environment to maintain the integrity of the electronic information in the event of system failure. Copies of all back-up tapes are maintained in secured off-site locations.
- All copies of client final reports are maintain electronically (e.g., Adobe Acrobat).

4.4 Request, Tender, and Contract Review

4.4.1 Contract Review

For many environmental sampling and analysis programs, testing design is site or program specific and does not necessarily "fit" into a standard laboratory service or product. It is STL's intent to provide both standard and customized environmental laboratory services to our clients. To ensure project success, technical staff performs a thorough review of technical and QC requirements contained in contracts. Contracts are reviewed for adequately defined requirements and STL's capability to meet those requirements.

All contracts entered into by STL are reviewed and approved by the appropriate management personnel to ensure that the laboratory's test methods are suitable to achieve these requirements and must ensure that the laboratory holds the appropriate certifications and approvals to perform the work. The review also includes the laboratory's capabilities in terms of turnaround time, capacity, and resources to provide the services requested, as well as the laboratory's ability to provide the documentation, whether hardcopy or electronic. If the laboratory cannot provide all services but intends to subcontract such services to another STL facility, this will be documented and discussed with the client prior to contract approval.

Any contract requirement or amendment to a contract communicated to STL verbally is documented and confirmed with the client in writing. Any discrepancy between the client's requirements and STL's capability to meet those requirements is resolved in writing before acceptance of the contract. Contract amendments, initiated by the client and/or STL, are documented in writing for the benefit of both the client and STL.

All contracts, QAPPs, Sampling and Analysis Plans (SAPs), contract amendments, and documented communications become part of the permanent project record as defined in Section 4.12.1.

4.4.2 Project-Specific Quality Planning

Communication of contract specific technical and QC criteria is an essential activity in ensuring the success of site specific testing programs. To achieve this goal, STL assigns a Project Manager to each client. The Project Manager is the first point of contact for the client. It is the Project Manager's responsibility to ensure that project specific technical and QC requirements are effectively evaluated and communicated to the laboratory personnel before and during the project (*Project Planning Process*; UPM-003). QA department involvement may be needed to assist in the evaluation of custom QC requirements.

Project Managers are the direct client contact and they ensure resources are available to meet project requirements. Although Project Managers do not have direct reports or staff in production, they coordinate opportunities and work with laboratory management and supervisory staff to ensure available resources are sufficient to perform work for the client's project. Project management is positioned between the client and laboratory resources.

Prior to work on a new project, the dissemination of project information and/or project opening meetings will occur to discuss schedules and unique aspects of the project. Items to be discussed may include the project Technical Profile (e.g., LabNet Project Notes) turn around times, holding times, methods, analyte lists, reporting limits, deliverables, sample hazards, or other special requirements. The Project Manager introduces new projects to the laboratory staff through Project Kick-Off Meetings (UPM-002). These meetings provide direction to the laboratory staff in order to maximize production and client satisfaction, while maintaining quality. In addition, the LabNet Project Notes are associated with each sample batch (e.g., Job) as a reminder upon sample receipt and analytical processing.

Any changes that may occur within an active project is agreed upon between the client/regulatory agency and the Project Manager/laboratory. These changes, e.g., use of a non-standard method or modification of a method, must be documented prior to implementation. Documentation pertains to any document, e.g., letter, variance, contract addendum, which has been signed by both parties.

Such changes are communicated to the laboratory through management Production Meetings, which are conducted twice per week. Such changes are updated to the Technical Profile / LabNet Project Notes and are introduced to the managers at these meetings. The laboratory staff is then introduced to the modified requirements via the Project Manager or the individual laboratory section manager. After the modification is implemented into the laboratory procedure, documentation of the modification is made in the case narrative of the data report(s).

STL strongly encourages our clients to visit the laboratory and hold formal or informal sessions with employees in order to effectively communicate ongoing client needs as well as project specific details for customized testing programs.

4.4.3 Data Quality Objectives

Data quality objectives (DQO) are qualitative and quantitative statements used to ensure the generation of the type, quantity, and quality of environmental data that will be appropriate for the intended application. Typically, DQOs are identified before project initiation and during the development of a QAPPs and SAPs. The analytical DQOs addressed in this section are precision, accuracy, representativeness, completeness, and comparability.

The components of analytical variability (uncertainty) can be estimated when QC samples of the right types and at the appropriate frequency are incorporated into the measurement process of the laboratory. STL incorporates numerous QC samples to obtain data for comparison with the analytical DQOs and to ensure that the measurement system is functioning properly. The control samples and their applications, described in Section 5.8.2, are selected based on regulatory, method- or client-specific requirements. Analytical QC samples for inorganic and organic analyses may include calibration blanks, instrument blanks, method blanks, laboratory control samples, calibration standards, MS, MSD, MD, surrogate spikes, and yield monitors.

The DQOs discussed below ensure that data are gathered and presented in accordance with procedures appropriate for its intended use, that the data is of known and documented quality, and are able to withstand scientific and legal scrutiny.

4.4.3.1 Precision

Precision is an estimate of variability. It is an estimate of agreement among individual measurements of the same physical or chemical property, under prescribed similar conditions. Precision is expressed either as Relative Standard Deviation (RSD) for greater than two measurements or as Relative Percent Difference (RPD) for two measurements. Precision is determined, in part, by analyzing data from LCSs, MS, MSD, and MD. A description of these control samples is provided in Section 5.8.2.

Precision also refers to the measurement of the variability associated with the entire process, from sampling to analysis. Total precision of the process can be determined by analysis of duplicate or replicate field samples and measures variability introduced by both the laboratory and field operations.

4.4.3.2 Accuracy

Accuracy is the degree of agreement between a measurement and the true or expected value, or between the average of a number of measurements and the true or expected value. It reflects the total error associated with a measurement.

Both random and systematic errors can affect accuracy. For chemical properties, accuracy is expressed either as a percent recovery (R) or as a percent bias (R - 100). Accuracy is determined, in part, by analyzing data from LCSs, MS and MSD.

Accuracy and Precision objectives employed by the laboratory are as defined in the CERCLA's Inorganic and Organic Statements of Work (SOW); statistically-derived control limits; or default limits as listed in each respective method SOP.

4.4.3.3 Representativeness

Representativeness is the degree to which data accurately and precisely represent a characteristic of a population, a variation in a physical or chemical property at a sampling point, or an environmental condition. Data representativeness is primarily a function of sampling strategy; therefore, the sampling scheme must be designed to maximize representativeness. Representativeness also relates to ensuring that, through sample homogeneity, the sample analysis result is representative of the constituent concentration in the sample matrix. STL makes every effort to analyze an aliquot that is representative of the original sample, and to ensure the homogeneity of the sample before sub-sampling.

4.4.3.4 Completeness

Completeness is defined as the percentage of measurements that are judged valid or useable. Factors negatively affecting completeness include the following: sample leakage or breakage in transit or during handling, loss of sample during laboratory analysis through accident or improper handling, improper documentation such that traceability is compromised, or sample result is rejected due to failure to conform to QC specifications. A completeness objective of greater than 90% of the data specified by the statement of work is the goal established for most projects.

4.4.3.5 Comparability

Comparability is a measure of the confidence with which one data set can be compared to another. To ensure comparability, all laboratory analysts are required to use uniform procedures (e.g., SOPs) and a uniform set of units and calculations for analyzing and reporting environmental data.

A measure of inter-laboratory comparability is obtained through the laboratory's participation in performance testing (PT) programs established with Water Supply (WS), Water Pollution (WP), and Solid Waste (SW) programs. In addition, the laboratory employs the use of NIST or EPA traceable standards, when available, to provide an additional measure of assurance of the comparability of data.

Project representativeness and comparability are dependent upon the sampling plan on a project specific basis, and are therefore not covered in this LQM. Assessment of site and collection representativeness and comparability is performed by the field engineer.

4.4.3.6 Additional DQOs

Method Detection Limits

The method detection limit (MDL) is the lowest concentration that can be detected for a given analytical method and sample matrix with 99% confidence that the analyte is present. The MDL is determined according to Appendix B of 40 CFR 136, "Guidelines Establishing Test Procedures for the Analysis of Pollutants". MDLs reflect a calculated (statistical) value determined under ideal laboratory conditions in a clean matrix, and may not be achievable in all environmental matrices. The laboratory maintains MDL studies for analyses performed; these are verified at least annually.

For the performance of non-routine methods, e.g., client/contract requirement, MDLs or Method Validation Studies will be completed on an as needed basis. The turnaround time for such studies will be as determined by the client and Project Manager. Such studies will be reviewed and approved by the client and/or regulatory agency prior to project implementation.

Instrument Detection Limits

There are a number of ways to determine Instrument Detection Limit (IDL) sensitivity (e.g., signal-to-noise ratio; precision of the low-level standard; lowest calibration curve point or the IDL study defined within CLP). The method and means in which IDLs are determined are documented and maintained in the QA department for each individual instrument.

IDLs are generated for each element by the metals laboratory quarterly via each instrument as specified in CLP. These limits are used to gauge instrument sensitivity and when routinely evaluated, instrument performance without the introduction of method variance can be determined.

Reporting Limits

Reporting Limits are defined as the lowest concentration of an analyte determined by a given method in a given matrix that the laboratory feels can be reported with acceptable quantitative error or client requirements, values specified by the EPA methods or other project and client requirements. The laboratory reporting limits are further related and verified by the lowest point on a calibration curve. Because of the high level of quantitative error associated with determinations at the level of the MDL, the laboratory endeavors to keep reporting limits higher than the MDL. Wherever possible, reporting is limited to values approximately 3-5x the respective MDL to ensure confidence in the value reported. Client specific requests for reporting to the IDL or MDL are special circumstances not to be confused with the previous statement. Data evaluated down to the MDL/IDL is qualified as estimated with a 'J' for organic analyses and a 'B' for inorganic analyses on the data report.

MDL studies are performed annually, and reporting limits are assessed. If the MDL does not meet the routine laboratory reporting limit or the method specified limit, it is repeated or the laboratory reporting limit is reassessed. If the laboratory continually demonstrates that the method reporting limits are not achieved, equipment, technique, and the method are reviewed to assure optimal performance or appropriate action is taken.

4.5 Subcontracting

Subcontracting is arranged with the documented consent of the client, in a timely response which shall not be unreasonably refused. All QC guidelines specific to the client's analytical program are transmitted to the subcontractor and agreed upon before sending the samples to the subcontract

facility. Proof of required certifications from the subcontract facility are maintained in the project records. Where applicable, specific QC guidelines, QAPPs, and/or SAPs are transmitted to the subcontract laboratory. Samples are subcontracted under formal Chain of Custody (COC).

Subcontract laboratories may receive an on-site audit by a representative of STL's QA staff if it is deemed appropriate by the QA Manager. The audit involves a measure of compliance with the required test method, QC requirements, as well as any special client requirements (e.g., Technical Profile and LabNet Project Notes).

Intra-company subcontracting may also occur between STL facilities. Intra-company subcontracting within STL is arranged with the documented consent of the client (e.g., QAPP). The originating laboratory is responsible for communicating all technical, quality, and deliverable requirements as well as other contract needs.

Project reports from both STL and external subcontractors are not altered and are included in their original form in the final project report provided by STL. This clearly identifies the data as being produced by a subcontractor facility. All data, as required in Section 5.9.4, is included.

4.6 Purchasing Services and Supplies

Evaluation and selection of suppliers and vendors is performed, in part, on the basis of the quality of their products, their ability to meet the demand for their products on a continuous and short term basis, the overall quality of their services, their past history, and competitive pricing. This is achieved through evaluation of objective evidence of quality furnished by the supplier, which can include certificates of analysis, recommendations, and proof of historical compliance with similar programs for other clients. To ensure that quality critical consumables and equipment conform to specified requirements, all purchases from specific vendors are approved by a member of the supervisory or management staff.

Chemical reagents, solvents, glassware, and general supplies are ordered as needed to maintain sufficient quantities on hand. Purchasing guidelines for equipment and reagents meet with the requirements of the specific method and testing procedures for which they are being purchased. The measurements for evaluation and selection of suppliers; the acceptance of supplies and services; and certificates of conformance are described in the procurement SOP (*Procurement Quality Assurance Process*; UQA-020).

4.6.1 Solvent and Acid Lot Verification

Pre-purchase approval is performed for solvents and acids purchased in large quantities unless a certificate of conformance has been furnished. These may include acetone, ethyl ether, hexane, methylene chloride, nitric acid, hydrochloric acid, sulfuric acid, and hydrogen peroxide. Each lot of incoming supplies requiring pre-approval is checked against the previously approved lot number. If the lot number is not approved, the lot is refused. If the lot number is an approved lot number, it is accepted and documented. Solvents and acids are pre-tested in accordance with STLs Corporate *Testing Solvents and Acids* procedure (S-T-001).

4.7 Service to the Client

4.7.1 Sample Acceptance Policy

Samples are considered "compromised" if the following conditions are observed upon sample receipt:

- Cooler and/or samples are received outside of temperature specification.
- Samples are received broken or leaking.
- Samples are received beyond holding time.
- Samples are received without appropriate preservation.
- Samples are received in inappropriate containers.
- COC does not match samples received.
- COC is not properly completed or not received.
- Breakage of any Custody Seal.
- Apparent tampering with cooler and/or samples.
- Headspace in volatiles samples.
- Seepage of extraneous water or materials into samples.
- Inadequate sample volume.
- Illegible, impermanent, or non-unique sample labeling.

When "compromised" samples are received, it is documented on the hardcopy COC, the LabNet Sample Receipt Checklist and on a Sample Discrepancy Report (SDR); and the client is contacted for instructions. If the client decides to proceed with the analysis, the project report will clearly indicate any of the above conditions and the resolution.

4.7.2 Client Confidentiality and Proprietary Rights

Data and sample materials provided by the client or at the client's request, and the results obtained by STL, shall be held in confidence (unless such information is generally available to the public or is in the public domain or client has failed to pay STL for all services rendered or is otherwise in breach of the terms and conditions set forth in the STL and client contract) subject to any disclosure required by law or legal process. Technical, business and proprietary information provided by a client and data/information generated by the laboratory are restricted for the use within the laboratory for purposes of accomplishing the project. Client information is not to be used on other projects or revealed except in conjunction with project work to anyone outside the laboratory without permission of the client.

STL's reports, and the data and information provided therein, are for the exclusive use and benefit of client, and are not released to a third party without written consent from the client (*Client Confidentiality*; UQA-004).

4.8 Complaints

Client inquiries, complaints or noted discrepancies are documented, communicated to management, and addressed promptly and thoroughly. The investigation of the cause, resolution and authorization

of corrective action is documented [*Sample Discrepancy Report (SDR), Resubmitted Data Request (RDR), Corrective Action Report (CAR)*; UQA-029].

Client complaints are documented by the employee receiving the complaint. The documentation can take the form of a Resubmitted Data Request (RDR) or in a format specifically designed for that purpose (e.g., phone conversation record or e-mail). The Laboratory Manager, Project Manager and/or QA Manager are informed of client complaints and assist in resolving the complaint.

The RDR is used after the client has received the analytical report and their specifications, expectations, or client satisfaction were not achieved. RDRs are prepared when clients request re-evaluation of submitted data, when additional information is requested or for general complaints.

The nature of the complaint is identified, documented and investigated, and an appropriate action is determined and taken. In cases where a client complaint indicates that an established policy or procedure was not followed, the QA department is required to conduct a special audit to assist in resolving the issue. A written confirmation, or letter to the client, outlining the issue and response taken is strongly recommended as part of the overall action taken.

The number and nature of client complaints is reported by the QA Manager in the QA Monthly report. Monitoring and addressing the overall level and nature of client complaints and the effectiveness of the solutions is part of the *Quality Systems Management Review* (UQA-002).

4.9 Control of Non-conformances

Non-conformances include any out of control occurrence. Non-conformances may relate to client specific requirements, procedural requirements, or equipment issues. All non-conformances in the laboratory are documented at the time of their occurrence on Corrective Action Reports (CARs) specifically formatted for each department or on a SDR.

All non-conformances that affect a sample and/or sample data become part of the affected project's permanent record. When appropriate, reanalysis is performed where QC data falls outside of specifications, or where data appears anomalous. If the reanalysis comes back within established tolerances, the results are approved. If the reanalysis is still outside tolerances, further reanalysis or consultation with the Section Manager, Project Manager or QA Manager for direction may be required. All records of reanalysis are kept with the project files.

Where non-conformances specifically affect a client's sample and/or data, the client is informed and action must be taken. Action can take the form of reporting and flagging the data, and including a description of the non-conformance in the project narrative.

4.10 Corrective Action

To consistently achieve technical and regulatory requirements, the laboratory data must be supported by an effective corrective action system. The system must be capable of isolating and rectifying both random and systematic errors. Identification of systematic errors, or errors that are likely to occur repetitively due to a defect or weakness in a system, is particularly valuable in maintaining an environment of continuous improvement in laboratory operations.

Mechanisms used to ensure problem definition include SOPs; internal and external audits and surveillances; and regular laboratory management meetings. When evaluation of performance against established criteria for good laboratory practices shows a condition that could adversely affect the quality of services provided, corrective action is initiated.

All corrective actions, whether immediate or long-term, will comprise the following steps to ensure a closed-loop corrective action process:

- Define the problem.
- Assign responsibility for investigating the problem.
- Determine a corrective action to eliminate the problem.
- Assign, and obtain commitment to, responsibility for implementing the corrective action.
- Implement the correction.
- Assess the effectiveness of the corrective action and verify that the corrective action has eliminated the problem.

4.10.1 Immediate Corrective Action

Immediate corrective actions to correct or repair non-conforming equipment and systems are generally initiated in response to adverse conditions identified through QC procedures. The analyst has relatively quick feedback that a problem exists, e.g., calibration does not meet or QC check samples exceed allowable criteria, and can take immediate action to repair the system.

The initial responsibility to monitor the quality of a function or analytical system lies with the individual performing the task or procedure. DQOs are evaluated against laboratory-established or against method or client specified QA/QC requirements. If the assessment reveals that any of the QC acceptance criteria are not met, the analyst must immediately assess the analytical system to correct the problem. When the appropriate corrective action measures have been defined and the analytical system is determined to be "in-control" or the measures required to put the system "in-control" have been identified and scheduled, the problem and resolution or planned action is documented in the appropriate logbook or CAR. Data generated by an analytical system that is determined to be out-of-control must never be released without approval of the Section Manager, QA Manager, Laboratory Manager and client notification.

When an acceptable resolution cannot be met or data quality is negatively affected, the analyst will notify their Section Manager and initiate an SDR. If an SDR is required, it is routed for proper authorizations and direction. Proper authorization and direction is given by the Project Manager and/or QA Manager. Based upon the circumstances and judgment of the Project Manager, the client may be notified of the situation.

Data generated concurrently with an out-of-control system will be evaluated for usability in light of the nature of the deficiency. If the deficiency does not impair the usability of the results, data will be reported and the deficiency will be noted in the case narrative. Where sample results may be impaired, the Project Manager is notified by a written SDR and appropriate corrective action (e.g., reanalysis) is taken and documented.

A CAR documents analytical problems at the bench level. This form allows for the documentation of the out-of-control situation, actions undertaken to correct the problem and a return-to-control status. All CARs are signed/dated by the respective laboratory section manager.

The QA Manager has the authority to stop the analysis, e.g., failure to meet method or project requirements, and to hold all analyses of samples affected by an out-of-control situation. The method cannot be restarted without appropriate documentation leading to the QA Manager's approval and sign-off.

4.10.2 Long-term Corrective Action

Long-term corrective action is generally initiated due to QA issues, which are most often identified during internal and external audits (Sections 4.13 & 4.14). Typically, a deeper investigation into the root cause of the nonconformance is warranted, and the problem may take much longer to identify and resolve. Staff training, method revision, replacement of equipment, and LabNet reprogramming are examples of long-term corrective action.

4.10.3 Responsibility and Closure

The Section Manager is responsible for correcting out-of-control situations, placing highest priority on this endeavor. Associated corrective actions, once verified for effectiveness, are incorporated into standard practices. Ineffective actions will be re-evaluated until acceptable resolution is achieved. Section Managers are accountable to the Laboratory Manager to ensure final acceptable resolution is achieved.

The QA Department also may implement a special audit (Section 4.13). The purpose of inclusion of the corrective action process in both routine and special audits is to monitor the implementation of the corrective action and to determine whether the action taken has been effective in overcoming the issue identified.

Any out-of-control situations that are not addressed acceptably at the laboratory level may be reported to the Corporate Quality Director by the QA Manager, indicating the nature of the out-of-control situation and problems encountered in solving the situation. This provides laboratory QA personnel non-laboratory management support, if needed, to ensure QA policies and procedures are enforced.

4.11 Preventative Action

The laboratory's preventive action programs improve, or eliminate potential causes of nonconforming product and/or nonconformance to the quality system. This preventive action process is a proactive continuous process improvement activity which can be initiated by clients, employees, business providers, and affiliates. The QA section has the overall responsibility to ensure that the preventive action process is in place, and that relevant information on actions is submitted for management review.

Preventive action opportunities may be identified from information obtained through activities related to but not limited to the corrective action process, performance evaluation program, internal audits, management review, and/or market trends, industry trends and competitive comparisons.

Established standard practices for preventive action are included in the *Preventive Action Measures* SOP (UQA-019); the *SDR / RDR / CAR* SOP (UQA-029) and the *Quality System Management Review* SOP (UQA-002). These procedures describe the information sources used to detect, analyze, and eliminate potential causes of nonconformities and to ensure effective implementation of solutions.

4.12 Records

4.12.1 Record Types

Record types are described in Table 4.

4.12.2 Record Retention

Data reports are filed electronically as .pdf files by sample job number. Hardcopy COC files are maintained and are filed in Job Number order.

Laboratory data, project management files, QA records (e.g., PT scores/corrective actions; MDLs/IDLs, statistical analysis, QAPPs, etc..), Human Resources information, etc.., are compiled by date order. The same procedure is followed both in current and archived hardcopy storage.

Upon archiving, a *Records Management Form* (CHI-22-05-032) is prepared for each storage box of records. This form documents the department, department manager, contents (description and dates), term of retention (e.g., no. of years) and an assigned identification number. The original of this form is maintained with the data management department with a carbon copy filed within the storage box. Upon purging of records, the individual department managers sign the original form as confirmation for the destruction of the associated data. This signature indicates that the laboratory has maintained the information for the required amount of time and is no longer required to store it.

Table 5 outlines the laboratory's standard record retention time. For raw data and project records, record retention is calculated from the date the project report is issued. For other records, such as Controlled Documents, QC, or Administrative Records, the retention time is calculated from the date the record is formally retired. Records related to the programs listed in Table 6 have lengthier retention requirements and are subject to the requirements in Section 4.12.3.

Table 4. STL Record Types

Raw Data	Controlled Documents	QC Records	Project Records	Administrative Records
See Section 3. Terms and Definitions	LQMs/ QAPPs	Audits/ Responses	COC Documentation	Accounting
	QMP (Corporate)	Certifications	Contracts and Amendments	Corporate Safety Manual, Permits, Disposal Records
	SOPs	SDRs/RDRs	Correspondence	Employee Handbook
		Logbooks*	QAPP	Personnel files, Employee Signature & Initials, Training Records
		Method & Software Validation, Verification	SAP	
		Standards Certificates	Telephone Logbooks	Technical and Administrative Policies
	Work Instructions	MDL/IDL/IDC Studies	E-mails	
		PTs	Electronic Data Report	
		Statistical Evaluations		

*Examples of Logbook types: Maintenance, Instrument, Preparation (standard and samples), Standard and Reagent Receipt, Archiving, and Balance Calibration.

Table 5. STL Record Retention

Record Type		Archival Requirement *
Raw Data	All* (Electronic Data Reports (.pdf & EDD)	5 Years from completion
Controlled Documents	All*	5 Years from document retirement date
QC	All*	5 Years from archival
Project	All*	5 Years from project completion
Administrative	Personnel/Training	Indefinitely
	Accounting	10 years

* Exceptions listed in Table 6.

4.12.3 Programs with Longer Retention Requirements

Some regulatory programs have longer record retention requirements than the laboratory's standard record retention time. These are detailed in Table 6 with their retention requirements and

client-specific requirements are listed in the *Record Retention and Purging* SOP (UDM-002). In these cases, the longer retention requirement is implemented and noted in the archive. If special instructions exist such that client data cannot be destroyed prior to notification of the client, the container or box containing that data is marked as to who to contact for authorization prior to destroying the data.

Table 6. Special Record Retention Requirements

Program	Retention Requirement
Colorado – Drinking Water	10 years
Commonwealth of MA – All environmental data 310 CMR 42.14	10 years
FIFRA – 40 CFR Part 160	Retain for life of research or marketing permit for pesticides regulated by EPA
Massachusetts – Drinking Water	10 years
Michigan Department of Environmental Quality – all environmental data	10 years
Minnesota – Drinking Water	10 years
Navy Facilities Engineering Service Center (NFESC)	10 years
OSHA - 40 CFR Part 1910	30 years
Pennsylvania – Drinking Water	10 years

4.12.4 Archives and Record Transfer

Archives are indexed such that records are accessible on either a project or temporal basis. Archives are protected against fire, theft, loss, deterioration, and vermin. Electronic records are protected from deterioration caused by magnetic fields and/or electronic deterioration. Access to archives is controlled and documented.

STL ensures that all records are maintained as required by the regulatory guidelines and per this LQM upon facility location change or ownership transfer. Upon facility location change, all archives are retained by STL in accordance with this LQM. Upon ownership transfer, all final test reports generated by the laboratory will be submitted to the clients if not previously provided. Any further record retention requirements will be addressed in the ownership transfer agreement and the responsibility for maintaining archives is clearly established.

In the event that the laboratory is closed, all final test reports generated by the laboratory will be submitted to the clients if not previously provided. All records will then be transferred to STL's corporate record storage location. All boxes and contents will be appropriately labeled with the dates of destruction (Refer to Tables 5 and 6) and managed in accordance their policies.

4.13 Internal Audits

Quality assurance audits and surveillances are conducted to assess the performance of laboratory systems in meeting technical, regulatory and client requirements; and to evaluate the operational

details of the QA program (*Internal Audits*; UQA-013). They provide a means for management to be apprised of, and to respond to, a potential problem before it actually impacts the laboratory operations. They also are a mechanism for ensuring closure of corrective actions resulting from external audits.

4.13.1 Audit Types and Frequency

A number of types of audits are performed at STL. These audit types and frequency are categorized in Table 7.

Table 7. Audit Types and Frequency

Audit Type	Performed by	Frequency
Systems	QA Department or Designee	Annual
Data	QA Department	~5% of All Projects or As Needed
Special	QA Department or Designee	As Needed

4.13.2 Systems Audits

Systems audits are technical in nature and are conducted on an ongoing basis by the QA Manager or the QA Specialist. Systems audits cover all departments of the facility, both operational and support. The review consists of laboratory systems, procedures, documentation and issues noted in external audits.

The audit report is issued by the QA Manager or QA Specialist within 14 calendar days of the audit. The audit report is addressed to the department Section Manager and copied to the QA department and the Laboratory Manager.

Written audit responses are required within 21 calendar days of the audit report issue. A maximum of one calendar month is given to address any recommended corrective actions. The audit response is directed to all individuals copied on the audit report. Where a corrective action may require longer than a calendar month to complete, the target date for the corrective action implementation is stated and evidence of the corrective action is submitted to the QA Department in the agreed upon time frame.

4.13.3 Data Audits

Data audits are focused to assess the level of customer service, SOP compliance, regulatory compliance, accuracy and completeness of test results and reports, documentation, and adherence to established QC criteria, laboratory SOPs, technical policy, and project specific QC criteria.

The QA Department provides feedback and/or corrections and revisions to project reports where necessary. Records of the data audits are kept, and the frequency of data audits is included in the monthly QA report. In performing data audits, it is essential that data be assessed in terms of differentiating between systematic and isolated errors. Upon noting anomalous data or occurrences in the data audits, the QA Department is responsible for seeking clarification from the

appropriate personnel, ascertaining whether the error is systematic or an isolated error, and overseeing correction and/or revision of the project report if necessary. Errors found in client project reports are revised and the revision sent to the client (Section 4.8). The QA Department is also responsible for assisting in the corrective action process where a data audit leads to identification of the need for permanent corrective action.

The frequency of data auditing may also be dependent upon specific clients and regulatory programs. All active laboratory logbooks and QC files are subject to periodic audits/ surveillances by the QA personnel.

4.13.4 Special Audits

Special audits are conducted on an as needed basis, generally as a follow up to specific issues such as client complaints, corrective actions, proficiency testing results, data audits, systems audits, validation comments, or regulatory audits. Special audits are focused on a specific issue, and report format, distribution, and timeframes are designed to address the nature of the issue.

4.14 External Audits

STL is routinely audited by clients and external regulatory authorities – both government and non-government. Whether the audit is scheduled or unannounced, full cooperation with the audit team is provided by the laboratory and administrative staff. STL recommends that the audits be scheduled with the QA Department so that all necessary personnel are available on the day of the audit.

4.15 Management Reviews

4.15.1 QA Reports to Management

A monthly QA report is prepared by QA Manager and forwarded to the Laboratory Manager, Project Managers, Section (Technical) Managers and the Corporate Quality Director. The reports include statistical results that are used to assess the effectiveness of the quality system. The format of the monthly report is shown in Figure 3.

4.15.2 Quality Systems Management Review

A quality systems management review is performed at least annually by the QA Manager. This review ensures that the laboratory's quality system is adequate to satisfy the laboratory's policies and practices, government requirements, certification, accreditation, approval requirements, and client expectations. Quality systems management reviews are accomplished through the evaluation and revision of this LQM, monthly quality assurance reporting and goal setting.

Management reviews of specific quality system elements may be performed through continuous improvement activities, monthly QA reports, process changes, SOP revisions, and/or audit reports/responses. Documentation of these reviews are not required unless it is inherent in the review mechanism (e.g., approval signatures on SOP revisions).

Figure 3. Monthly QA Report Format

1. Audits
   - External audits completed.
   - External audits schedules.
   - Internal system audits scheduled.
   - Internal system audits completed.
     - Significant or repeat deficiencies.
   - Internal training record audits.
   - Internal data audits.
     - Significant or repeat deficiencies.

2. Revised Reports/Client Complaints
   - Revised reports.
   - Customer complaints.

3. Certification Changes
   - Certification Status
   - Certification Parameter List

4. Proficiency Testing (PT)
   - Scores.
   - Repeat failures and/or significant problems.
   - PT Study status.

5. Miscellaneous QA and Operational Issues
   - Standard Operating Procedure (SOP) status measurement.
   - Preventive Actions.

6. QAPP/Project Review Status
   - Report the activity of QAPP/Project review/writing activities.

5.0 Technical Requirements

5.1 Personnel

5.1.1 General

STL management believes that its highly qualified and professional staff is the single most important aspect in assuring the highest level of data quality and service in the industry. The staff consists of professionals and support personnel that include the following positions:

- Laboratory Manager
- QA Manager
- Health & Safety Coordinator / Waste Management
- Project Manager
- Information Technology Manager
- Department Section Manager (Technical Manager)

- Analyst
- Sample Custodian
- Technician
- Quality Assurance Specialist
- Data Review Specialist

In order to ensure that employees have sufficient education and experience to perform a particular task, job descriptions are developed for all personnel (Section 4.1.2).

5.1.2 Training

STL is committed to furthering the professional and technical development of employees at all levels. Selection of qualified candidates for laboratory employment begins with documentation of minimum education, training, and experience prerequisites needed to perform the prescribed task. Minimum education and training requirements for STL employees are outlined in Table 8.

Orientation to the laboratory's policies and procedures, in-house method training, and employee attendance at outside training courses and conferences all contribute toward employee proficiency. The QA section in conjunction with the Human Resources section are responsible for maintaining documentation of these activities.

Each laboratory section maintains documentation associated with analytical training (e.g., training records, document control). The QA department maintains [continued] method proficiency (e.g., MDLs, IDMPs, PT Sample Tracking, LCSs). This information is available to managers and staff for planning and evaluation.

Human Resources maintains documentation and attestation forms on employment status & records; benefit programs; timekeeping/payroll; and employee conduct (e.g., ethics). This information is maintained in the employee's secured personnel file.

Table 8. STL Employee Minimum Training Requirements

Specialty	Experience
General Chemistry and Instrumentation	Six months
Gas Chromatography	One year
Atomic Absorption	One year
Mass Spectrometry	One year
Spectra Interpretation	Two years

Required Training	Time Frame [1]	Employee Type
Environmental Health & Safety	Month 1	All
Quality Assurance	Quarter 1	All
Demonstration of Capability (DOC)	Prior to unsupervised method performance	Technical

[1] From the date of initial employment unless otherwise indicated.

When an analyst does not meet these requirements, they can perform a task under the supervision of a qualified analyst, peer reviewer or section manager, and are considered an analyst in training. The person supervising an analyst in training is accountable for the quality of the analytical data and must review and approve data and associated corrective actions.

DOCs are performed by the analysis of four replicate QC samples. Results of successive LCS analyses can be used to fulfill the DOC requirement. The accuracy and precision, measured as average recovery and standard deviation (using n-1 as the population), of the 4 replicate results are calculated and compared to those in the test method (where available). If the test method does not include accuracy and precision requirements, the results are compared to target criteria set by the laboratory. The laboratory sets the target criteria such that they reflect the DQOs of the specific test method or project. A DOC Certification Statement is recorded and maintained in the employee's training file. Tabulated results summary and raw data are completed and signed by the analyst and section manager with the proper entries made onto the analysts training record. The data is submitted to the QA department for entry into the master IDMP spreadsheet and filing. Figure 4 shows an example of a DOC Certification Statement.

Further details of the laboratory's training program are described in the Laboratory Training SOP (UQA-014).

5.1.3 Ethics Policy

Establishing and maintaining a high ethical standard is an important element of a Quality System. In order to ensure that all personnel understand the importance the company places on maintaining high ethical standards at all times; STL has established an Ethics Policy P-L-006 and an Ethics Agreement (Figure 5). Each employee signs the Ethics Agreement, signifying agreed compliance with its stated purpose.

Violations of this Ethics Policy will not be tolerated. Employees who violate this policy will be subject to disciplinary actions up to and including termination. Criminal violations may also be referred to the Government for prosecution. In addition, such actions could jeopardize the Company's ability to do work on Government contracts, and for that reason, the Company has a Zero Tolerance approach to such violations.

Ethics is also a major component of the QA training program. Each employee is trained in ethics within three months of hire in a QA training program that includes an overview of regulatory programs and program goals, a review of the ethics statement, and group discussions about data integrity and data misrepresentation. Employees are trained as to the legal and environmental repercussions that result from data misrepresentation. A data integrity hotline is maintained by STL and administered by the Corporate Quality Director.

Figure 4. Demonstration of Capability Certification Statement

Demonstration of Capability
Certification Statement

STL Chicago
2417 Bond Street
University Park, IL 60466

Analyst Name:_____
SOP No.:_____
Method No.:_____
Description:_____
Matrix:_____
Effective Date:_____

We the undersigned certify that:

1. The analyst identified above, using the cited test method(s), which is in use at this laboratory for the analyses of samples under the National Environmental Laboratory Accreditation Program, have met the Demonstration of Capability.
2. The test method(s) was performed by the analyst identified on this certification.
3. A copy of the reference method and laboratory-specific SOP(s) are available for all personnel on-site.
4. The data associated with the demonstration capability are true, accurate, complete and self-explanatory.
5. All raw data (including a copy of this certification form) necessary to reconstruct and validate these analyses have been retained at the laboratory, and that the associated information is well organized and available for review by authorized assessors.

Technical Manager	Signature	Date
Quality Manager	Signature	Date

Figure 5. STL Ethics Agreement (P-L-006)

I, _____(print name) understand that high standards of integrity are required of me with regard to the duties I perform and the data I report in connection with my employment at the Company. I agree that in the performance of my duties at the Company:

- *I will not intentionally report data values that are not the actual values obtained;*
- *I will not intentionally report the dates, times, sample or QC identifications, or method citations of data analyses that are not the actual dates, times, sample or QC identifications, or method citations;*
- *I will not intentionally misrepresent another individual's work; and*
- *If a supervisor or a member of STL management requests me to engage in or perform an activity that I feel is compromising data validity or quality, I will not comply with the request and report this action immediately to a member of the upper management, up to and including the president of Severn Trent Laboratories, Inc.*
- *I will not intentionally report data values that do not meet established quality control criteria as set forth in the Method and/or Standard Operation Procedures, or as defined by Company Policy.*
- *I agree to inform my Supervisor of any accidental reporting of non-authentic data by me in a timely manner. I agree to inform my Supervisor of any accidental or intentional reporting of non-authentic data by other employees. I have read this Ethics Agreement and understand that failure to comply with the conditions stated above will result in disciplinary action, up to and including termination from the Company.*

Compliance with this policy of business ethics and conduct is the responsibility of every STL employee. Disregard or failing to comply with this standard of business ethics and conduct will result in disciplinary action, up to and including termination of employment.

_____
EMPLOYEE'S NAME (printed)

_____
EMPLOYEE'S SIGNATURE

5.2 Facilities

The laboratory is a secure facility with controlled and documented access. Access is controlled by various measures including locked doors, electronic access cards, security codes, and a staffed reception area. All visitors sign in and are escorted by STL personnel while at the facility. The laboratory is locked at all times, unless a receptionist is present to monitor building access (e.g., between the hours of 8:00 a.m. and 5:00 p.m. Monday through Friday).

The facility is designed for efficient, automated high-quality operations. The laboratory is equipped with Heating, Ventilation, and Air Conditioning (HVAC) systems appropriate to the needs of environmental testing laboratories. Environmental conditions in the facility, such as hood flow, are routinely monitored and documented.

The facility is equipped with structural safety features. Each employee is familiar with the location, use, and capabilities of general and specialized safety features associated with their workplace. STL also provides and requires the use of protective equipment including safety glasses, protective clothing, gloves, etc..

5.3 Test Methods

Routine analytical services are performed using standard EPA-approved methodology. In some cases, modification of standard approved methods may be necessary to provide accurate analyses of particularly complex matrices.

5.3.1 Method Selection

Since numerous methods and analytical techniques are available, continued communication between the client and laboratory is imperative to assure the correct methods are utilized. Once client methodology requirements are established, this and other pertinent information is summarized by the Project Manager in a Technical Profile and within LabNets Project Notes feature. These mechanisms ensure that the proper analytical methods are applied when the samples arrive for log-in. For non-routine analytical services (e.g., special matrices, non-routine compound lists, etc..), the method of choice is selected based on client needs and available technology.

Most of the test methods performed at STL originate from test methods published by a regulatory agency such as the US EPA and other state and federal regulatory agencies. These include, but are not limited to, the following published compendiums of test methods. A listing of methods in which the laboratory is capable of performing is listed in laboratory's *Methods Capabilities* Work Instruction (CHI-22-09-255).

Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act, and Appendix A-C; 40 CFR Part 136, USEPA Office of Water.

Methods for Chemical Analysis of Water and Wastes, EPA 600 (4-79-020), 1983.

Methods for the Determination of Inorganic Substances in Environmental Samples, EPA-600/R-93/100, August 1993.

Methods for the Determination of Metals in Environmental Samples, EPA/600/4-91/010, June 1991. Supplement I: EPA-600/R-94/111, May 1994.

Methods for the Determination of Organic Compounds in Drinking Water, EPA-600/4-88-039, December 1988, Revised, July 1991, Supplement I, EPA-600-4-90-020, July 1990, Supplement II, EPA-600/R-92-129, August 1992.

NIOSH Manual of Analytical Methods, 4th ed., August 1994.

Statement of Work for Inorganics Analysis, ILM04.0, USEPA Contract Laboratory Program Multi-media, Multi-concentration.

Statement of Work for Organics Analysis, OLM04.2 and OLC02.1, USEPA Contract Laboratory Program, Multi-media, Multi-concentration.

Standard Methods for the Examination of Water and Wastewater, 18th/19th/20th edition; Eaton, A.D. Clesceri, L.S. Greenberg, A.E. Eds; American Water Works Association, Water Pollution Control Federation, American Public Health Association: Washington, D.C.

Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW-846), Third Edition, September 1986, Final Update I, July 1992, Final Update IIA, August 1993, Final Update II, September 1994; Final Update IIB, January 1995; Final Update III, December 1996.

Annual Book of ASTM Standards, American Society for Testing & Materials (ASTM), Philadelphia, PA.

The laboratory reviews updated versions to all the aforementioned references for adaptation based upon capabilities, instrumentation, etc.., and establishes an implementation schedule. As such, the laboratory strives to perform only the latest versions of each approved method.

5.3.2 SOPs

STL maintains an SOP Index (CHI-22-09-SOP List) for both Method and Process SOPs. Method SOPs are maintained to describe a specific test method. Process SOPs are maintained to describe function and processes not related to a analytical testing (e.g., administrative procedures).

Method SOPs contain the following information:

Title Page with Document Name, Document Number, Revision Number, Effective Date, Page Numbers and Total # of Pages, Authorized Signatures, Dates and Proprietary Information Statement (Figure 6).

1. Identification of Test Method
2. Applicable Matrix
3. Scope and Application, including test analytes
4. Summary of the Test Method
5. Reporting Limits
6. Definitions
7. Interferences
8. Safety
9. Equipment and Supplies
10. Reagents and Standards
11. Sample Collection, Preservation and Storage
12. Quality Control
13. Calibration and Standardization
14. Procedure
15. Calculations
16. Method Performance
17. Pollution Prevention
18. Data Assessment and Acceptance Criteria for Quality Control Measures
19. Corrective Actions for Out-of-Control Data
20. Contingencies for Handling Out-of-Control or Unacceptable Data
21. Waste Management
22. References
23. Tables, Diagrams, Flowcharts and Validation Data

Process SOPs contain the following information:

Title Page with Document Name, Document Number, Revision Number, Effective Date, Page Numbers and Total # of Pages, Authorized Signatures, Dates and Proprietary Information Statement (Figure 6).

1. Scope
2. Summary

3. Definitions
4. Responsibilities
5. Procedure
6. References
7. Tables, Diagrams, and Flowcharts

The QA Department is responsible for maintenance of SOPs, archival of SOP historical revisions, maintenance of an SOP index, and records of controlled distribution. SOPs, at a minimum, undergo annual review (12-18 months). Where an SOP is based on a published method, the laboratory maintains a copy of the reference method.

Figure 6. Proprietary Information Statement

SOP Change Form

The SOP Change Form is used for implementation, documentation, and authorization of changes to SOPs (*SOP Change Protocol*; UQA-032). Immediate changes in SOPs may be necessary to accommodate improvements; to implement acceptable changes in practices; or to correct potential errors in the existing version. The reason for the change will be identified and a detailed description of the procedure change will be presented. Since this form will become part of the referenced SOP, until such time that the SOP is updated, it must be legible and comprehensible. The Change Form must provide an exact description and identify the affected sections.

Once this form is completed and changes are authorized, it becomes an official part of the SOP for which it revises, and is subject to all document control and records management policies.

5.3.3 Method Validation

Laboratory developed methods are validated and documented according to the procedure described in Section 5.3.5.

5.3.4 Method Verification

Method verification is required when a validated standard test method or a method modification is implemented. The level of activity required for method verification is dependent on the type of method being implemented, or on the level of method modification and its affect on a method's robustness. Method modification often takes advantage of a method's robustness, or the ability to make minor changes in a method without affecting the method's outcome. Method verification may require some, but not all, of the activities described in Section 5.3.5.

5.3.5 Method Validation and Verification Activities

Before analyzing samples by a particular method, method validation and/or method verification must occur. A complete validation of the method is required for laboratory developed methods. While method validation can take various courses, the following activities can be required as part of method validation. Method validation records are designated QC records and are archived accordingly.

Determination of Method Selectivity
Method selectivity is demonstrated for the analyte(s) in the specific matrix or matrices. In some cases, to achieve the required selectivity for an analyte, a confirmation analysis is required as part of the method.

Determination of Method Sensitivity
Sensitivity can be both estimated and demonstrated. Whether a study is required to estimate sensitivity depends on the level of method development required when applying a particular measurement system to a specific set of samples. Where estimations and/or demonstrations of sensitivity are required by regulation or client agreement, such as the procedure in 40 CFR Part 136 Appendix B, under the Clean Water Act, these shall be followed. The laboratory determines MDLs are described in Section 4.4.3.6 and within UQA-017.

Relationship of Limit of Detection (LOD) to the Quantitation Limit (QL)
An important characteristic of expression of sensitivity is the difference in the LOD and the QL. The LOD is the minimum level at which the presence of an analyte can be reliably concluded. The QL is the minimum level at which both the presence of an analyte and its concentration can be reliably determined. For most instrumental measurement systems, there is a region where semi-quantitative data is generated around the LOD (both above and below the estimated MDL or LOD) and below the QL. In this region, detection of an analyte may be confirmed but quantification of the analyte is unreliable within the accuracy and precision guidelines of the measurement system. When an analyte is detected below the QL, and the presence of the analyte is confirmed by meeting the qualitative identification criteria for the analyte, the analyte can be reliably reported, but the amount of the analyte can only be estimated. If data is to be reported in this region, it must be done so with a qualification that denotes the semi-quantitative nature of the result.

Determination of Interferences
A determination that the method is free from interferences in a blank matrix is performed.

Determination of Range
Where appropriate, a determination of the applicable range of the method may be performed. In most cases, range is determined and demonstrated by comparison of the response of an analyte in a curve to established or targeted criteria. The curve is used to establish the range of quantitation and the lower and upper values of the curve represent upper and lower quantitation limits. Curves are not limited to linear relationships.

Demonstration of Capability
DOCs are performed prior to method performance.

Determination of Accuracy and Precision
Accuracy and precision studies are generally performed using replicate analyses, with a resulting percent recovery and measure of reproducibility (standard deviation, relative standard deviation) calculated and measured against a set of target criteria.

Documentation of Method
The method is formally documented in an SOP. If the method is a minor modification of a standard laboratory method that is already documented in an SOP, an SOP Appendix describing the specific differences in the new method is acceptable in place of a separate SOP.

Continued Demonstration of Method Performance
Continued demonstration of Method Performance is addressed in the SOP. Continued demonstration of method performance is generally accomplished by batch specific QC samples such as LCS and Method Blanks.

5.3.6 Data Reduction and Review

Analytical data are entered/downloaded directly into LabNet or recorded on pre-formatted bench sheets that are paginated and bound into laboratory logbooks. These logbooks are issued and controlled by the laboratory's QA Section. A unique document control code is assigned to each book to assure that chronological record keeping is maintained. Analytical data may be electronically stored as a secure .pdf file to which the analyst applies an electronic signature.

Analytical data is referenced to a unique sample identification number for internal tracking and reporting. Both LabNet entries and logbook pages contain the following information, as applicable: analytical method, analyst, date, sequential page number, associated sample numbers, standard concentrations, instrument settings, and raw data. Entries are in chronological order and maintained so as to enable reconstruction of the analytical sequence.

The analyst is responsible for entering / recording all appropriate information, and for signing and dating all logbook entries daily. All entries and logbook pages are reviewed for completeness by a supervisor, peer reviewer or the analyst themselves. Data review checklists document the analytical review of the LabNet entries, logbook and associated QC indicators. Copies of instrument outputs (chromatograms, mass spectra, etc..) are maintained on file or electronically with the analyst's signature/initials and date.

5.3.6.1 Data Reduction

The complexity of the data reduction depends on the analytical method and the number of discrete operations involved (e.g., extractions, dilutions, instrument readings and concentrations). The analyst calculates the final results from the raw data or uses appropriate computer programs to assist in the calculation of final reportable values.

For manual data entry, e.g., Wet Chemistry, the data is reduced by the analyst and then verified by the section manager or alternate analyst prior to updating the data in LabNet. The spreadsheets, or any other type of applicable documents, are signed by both the analyst and alternate reviewer to confirm the accuracy of the manual entry(s).

Manual integration of peaks will be documented and reviewed and the raw data will be flagged in accordance with the STL Corporate SOP entitled *Acceptable Manual Integration Practices* (S-Q-004).

Copies of all raw data and the calculations used to generate the final results, such as bound logbooks, are retained on file for a minimum of 5 years or as otherwise requested by the client/project.

Calculations and data reduction steps for various methods are summarized in the respective analytical SOPs or program requirements.

5.3.6.2 Data Review

All data, regardless of regulatory program or level of reporting, are subject to a thorough review process. The individual analyst continually reviews the quality of the data through calibration checks, quality control sample results and performance evaluation samples. Data review is initiated by the analyst during, immediately following, and after the completed analysis.

All levels of the review are documented on Data Review Checklists that are specific to each laboratory section (identified via Work Instruction numbers).

Primary Review

The primary review is often referred to as a "bench-level" review. In most cases, the analyst who generates the data (e.g., logs in, prepares and/or analyzes the samples) is the primary reviewer. In some cases, an analyst may be reducing data for samples run by an auto-sampler set up by a different analyst. In this case, the identity of both the analyst and the primary reviewer is identified in the raw data.

One of the most important aspects of primary review is to make sure that the test instructions are clear, and that all project specific requirements have been understood and followed.

Once an analysis is complete, the primary reviewer ensures, where applicable, that:

- Sample preparation information is complete, accurate, and documented.
- Calculations have been performed correctly.
- Quantitation has been performed accurately.
- Qualitative identifications are accurate.
- Manual integrations are appropriate.

- Data flags to indicate manual integrations are recorded.
- Manual integrations are authorized by a date and signature or initials of primary analyst.
- Client specific requirements have been followed.
- Method and process SOPs have been followed.
- Method QC criteria have been met.
- QC samples are within established limits.
- Dilution factors are correctly recorded and applied.
- Non-conformances and/or anomalous data have been properly documented and appropriately communicated.
- COC procedures have been followed.
- Primary review is documented by date and initials/signature of primary analyst.

Any anomalous results and/or non-conformances noted during the Primary Review are documented on the Data Review Checklist and on an SDR; and are communicated to the Section Manager and the Project Manager for resolution. Resolution can require sample reanalysis, or it may require that data be reported with a qualification. Non-conformances are documented per Section 4.9.

Secondary Review

The secondary review is also a complete technical review of a data and is performed by the Section Manager, analyst or data specialist. The secondary review is documented on the same Data Review Checklist as the primary review.

The following items are reviewed:

- Qualitative Identification
- Quantitative Accuracy
- Calibration
- QC Samples
- Method QC Criteria
- Adherence to method and process SOPs
- Accuracy of Final Client Reporting Forms
- Manual Integrations – Minimal requirement is to spot-check raw data files for manual integration, as verified by date and initials or signature of secondary data reviewer. Some regulatory programs require 100% secondary review of manual integrations.
- Completeness
- Special Requirements/Instructions

If problems are found during the secondary review, the reviewer must work with the appropriate personnel to resolve them. If changes are made to the data, such as alternate qualitative identifications, identifications of additional target analytes, re-quantitation, or re-integration, the secondary reviewer must contact the laboratory analyst and/or primary reviewer of the data so that the primary analyst and/or reviewer is aware of the appropriate reporting procedures.

Completeness Review

The completeness review includes the generation of a project narrative and/or cover letter which outlines anomalous data and non-compliances using project narrative notes and SDRs or CARs

(non-compliance reports) generated during the primary and secondary review. The completeness review addresses the following items:

- Is the project report complete?
- Does the data meet with the client's expectations?
- Were the data quality objectives of the project met?

Are QC outages and/or non-conformances approved and appropriately explained in the narrative notes?

The laboratory Section Manager(s), Data Management personnel and the Project Manager contribute to the completeness review.

5.3.7 Data Integrity and Security

This section details those procedures that are relevant to computer systems that collect, analyze, and process raw instrumental data, and those that manage and report data.

Security and Traceability

Access to the laboratory's LabNet system, STL's proprietary LIMS, that collects, analyzes, and processes raw instrumental data, and those that manage and report data is both controlled and recorded. System users are granted access levels that are commensurate with their training and responsibilities.

Control of the system is accomplished through limitation of access to the system by users with the education, training and experience to perform the task knowledgeably and accurately. System users are granted privileges that are commensurate with their experience and responsibilities.

Computer access is tracked by using unique login names and passwords for all employees that have access to the computer system. Entries and changes are documented with the identity of the individual making the entry, and the time and date. Where a computer system is processing raw instrumental data, the instrument identification number as described in Section 5.4.1 is recorded. The system has the capability of maintaining audit trails to track entries and changes to the data. This function is activated on any computer system that has that capability (e.g., Target).

Verification

All the LabNet software programs have been verified prior to use and prior to the implementation of any version upgrades. Verification involves assessing whether the computer system accurately performs its intended function. Verification generally is accomplished by comparing the output of the program with the output of the raw data manually processed, or processed by the software being replaced. All records of the verification are retained as QC records.

Validation

Software validation involves documentation of specifications and coding as well as verification of results. Software validation is performed on all in house programs. Records of validation include original specifications, identity of code, printout of code, software name, software version, name of individual writing the code, comparison of program output with specifications, and verification records as specified above. Records of validation are retained as QC records.

Auditing
STLs LabNet System Managers continually review the control, security, and tracking of IT systems and software.

Version Control
The laboratory maintains copies of outdated versions of software and associated manuals for all software in use at the laboratory for a period of 5 years from its retirement date. The associated hardware, required to operate the software, is also retained for the same time period.

5.4 Equipment

5.4.1 Equipment Operation

STL is committed to routinely updating and automating instrumentation. The laboratory maintains state of the art instrumentation to perform the analyses within the QC specifications of the test methods. The laboratory maintains an Equipment Tracking Form (CHI-22-09-068) for each piece of equipment and instrumentation that documents the following information:

- Identity
- Date In Service
- Manufacturer's Name, Model Number, Serial Number
- Current Location
- Preventative Maintenance Schedule

All equipment is subject to rigorous checks upon its receipt, upgrade, or modification to establish that the equipment meets with the selectivity, accuracy, and precision required by the test method for which it is to be used. All manufacturer's operations and maintenance manuals are kept up to date and accessible for the use of the equipment operator. Documentation of equipment usage is maintained using analytical run and maintenance logbooks.

5.4.2 Equipment Maintenance

STL employs a system of preventative maintenance in order to ensure system up time, minimize corrective maintenance costs and ensure data validity. All routine maintenance is performed as recommended by the manufacturer and may be performed by an analyst, instrument specialist or outside technician. Maintenance logbooks are kept on all major pieces of equipment in which both routine and non-routine maintenance is recorded.

Any item of equipment or instrumentation that has been subjected to overloading or mishandling, provides suspected results, has been shown by verification or otherwise to be defective, is new or not been used for an extended period of time, is taken out of services and tagged as "DO NOT USE INSTRUMENT". The tag is signed/dated by the person removing the item from service and noted as to the reason of in-operation *(Instrument and Equipment Out-of-Service Tagging*; UQA-012).

Any instrumentation that is brought back on-line must have MDLs and DOCs performed and have acceptance within prescribe criteria; or calibrated by a certified agency (e.g., balances or Class S

weights) and tagged as being within calibration specifications; and proven to provide consistent measurements (e.g., refrigerators, eppendorf pipettes, ovens).

The return to analytical control following instrument repair is documented in the maintenance logbook. Maintenance logbooks are retained as QC records. Notation of the date and maintenance activity is recorded each time service procedures are performed. Maintenance logbooks are retained as QA records.

Maintenance contracts are held on specific pieces of equipment where outside service is efficient, cost-effective, and necessary for effective operation of the laboratory. Table 9 lists STL's major equipment and the suggested maintenance procedures.

Table 9. Major Equipment Maintenance

Instrument	Procedure	Frequency
AA (Graphite Furnace)	Clean lens and furnace head	Daily
	Replace windows	As required
	Check or change cuvette	Daily
	Check & drain compressor drain	Daily
	Clean atomizer cell/furnace hood	Daily
	Nebulizer cleaned/dried	Weekly or as required
	Check/change marble stones	Weekly
	Clean filters	Weekly
	Change graphite tube/platform	As required
	Empty waste container	Daily
	Remove carbon tube and check wear	Daily
	Check sample introduction probe	Daily
Leeman Mercury Analyzer	Check tubing for wear	Daily
	Fill rinse tank with 10% HCl	Daily
	Insert clean drying tube filled with Magnesium Perchlorate	Daily
	Fill reductant bottle with 10% Stannous Chloride	Daily
ICP	Check pump tubing	Daily
	Check liquid argon supply	Daily
	Check fluid level in waste container	Daily
	Check filters	Weekly
	Clean or replace filters	As required
	Check torch	Daily
	Check sample spray chamber for debris	Monthly
	Clean and align nebulizer	Monthly
	Check entrance slit for debris	Monthly
	Change printer ribbon	As required
	Replace pump tubing	As required

Table 9. Major Equipment Maintenance

Instrument	Procedure	Frequency
UV-Vis Spectrophotometer	Clean ambient flow cell	As required
	Precision check/alignment of flow cell	As required
	Wavelength verification check	Semi-annually
Auto Analyzers	Clean sampler	Daily
	Check all tubing	Daily
	Clean inside of colorimeter	Daily
	Clean pump well and pump rollers	Quarterly
	Clean wash fluid receptacle	Weekly
	Oil rollers/chains/side rails	Weekly
	Clean optics and cells	Quarterly
Hewlett Packard GC/MS	Ion gauge tube degassing	As required
	Pump oil-level check	Monthly
	Pump oil changing	Semi-annually
	Analyzer bake-out	As required
	Analyzer cleaning	As required
	Resolution adjustment	As required
	COMPUTER SYSTEM AND PRINTER:	
	Air filter cleaning	As required
	Change data system air filter	As required
	Printer head carriage lubrication	As required
	Paper sprocket cleaning	As required
	Drive belt lubrication	As required
Gas Chromatograph	Compare standard response to previous day or since last initial calibration	Daily
	Check carrier gas flow rate in column	Daily via use of known compound retention
	Check temp. of detector, inlet, column oven	Daily
	Septum replacement	As required
	Glass wool replacement	As required
	Check system for gas leaks with SNOOP	W/cylinder change as required
	Check for loose/frayed wires and insulation	Monthly
	Visually check for shifting of column packing material resulting in forward movement beyond the bottom of the column exit or settling in excess of 1/2" from the glass wool plug at the column inlet	As needed
	Bake injector/column	As Required
	Change/remove sections of guard column	As Required
	Replace connectors/liners	As Required
	Change/replace column(s)	As Required

Table 9. Major Equipment Maintenance

Instrument	Procedure	Frequency
Electron Capture Detector (ECD)	Detector wipe test (Ni-63) Detector cleaning	Semi-annually As required
Flame Ionization Detector (FID)	Detector cleaning	As required
Photoionization Detector (PID)	Change O-rings Clean lamp window	As required As required
HPLC	Change guard columns Change lamps Change pump seals Replace tubing Change fuses in power supply Filter all samples and solvents Change autosampler rotor/stator	As required As required Semi-annually or as required As required As required Daily As required
Balances	Class "S" traceable weight check Clean pan and check if level Field service	Daily, when used Daily At least Annually
Conductivity Meter	0.01 M KCl calibration Conductivity cell cleaning	Daily As required
Turbidimeter	Check light bulb	Daily, when used
Deionized/Distilled Water	Check conductivity Check deionizer light Monitor for VOA's System cleaning Replace cartridge & large mixed bed resins	Daily Daily Daily As required As required
Drying Ovens	Temperature monitoring Temperature adjustments	Daily As required
Refrigerators/ Freezers	Temperature monitoring Temperature adjustment Defrosting/cleaning	Daily As required As required
Vacuum Pumps/ Air Compressor	Drained Belts checked Lubricated	Weekly Monthly Semi-annually
pH/Specific Ion Meter	Calibration/check slope Clean electrode	Daily As required
BOD Incubator	Temperature monitoring Coil and incubator cleaning	Daily Monthly
Centrifuge	Check brushes and bearings	Every 6 months or as needed

Table 9. Major Equipment Maintenance

Instrument	Procedure	Frequency
Water baths	Temperature monitoring Water replaced	Daily Monthly or as needed

5.4.3 Equipment Verification and Calibration

All equipment is calibrated prior to use (Initial Calibration) to establish its ability to meet the QC guidelines contained in the test method for which the instrumentation is to be used. All sample measurements are made within the calibrated range of the instrument and in compliance with method requirements. The calibration data, which includes instrument conditions and standard concentrations, is documented in pre-formatted instrument runlogs or within LabNet itself. The preparation of all reference materials used for calibration is documented via LabNet.

Once an instrument is calibrated, ongoing instrument calibration is demonstrated (Continuing Calibration) at the appropriate frequency as defined in the test method. Refer to the STL Corporate Policy *Selection of Calibration Points* (P-T-001), for guidance on using calibration data. Any instrument that is deemed to be malfunctioning is clearly marked and taken out of service. When the instrument is brought back into control, acceptable performance is documented.

5.4.3.1 Instrument Calibration

Specific instrument calibration procedures for various instruments are summarized further in this section, and detailed in the respective analytical methods. Typically, more than one analytical method is available for an analysis. These various methods and other program requirements (e.g., U.S. EPA CLP, AFCEE, NFESC, USACE, QAPPs, contracts, etc..) may specify different calibration requirements. Therefore, calibration details as specified in the respective laboratory SOPs, Technical Profiles, QAPP, program requirements, and contracts supersede the general instrument calibration procedures are described further in Table 10. Complete details are provided in each method SOP.

Table 10. Minimum Instrument Calibration Procedures

Technique	Activity	Minimum Requirements
Metals (ICAP)	Initial Calibration	Following a period of time sufficient to warm up the instrument, the ICP is calibrated prior to each analytical run or minimally every 24 hours. Calibration standards are prepared from reliable reference materials and contain all metals for which analyses are being conducted. Working calibration standards are prepared fresh daily. Quarterly, multi-concentration calibration is performed to document linearity. On a day-to-day basis, 4 calibration standards (blank, high standard, 50% standard, and 20% standard) are analyzed. Prior to an analytical run, the instrument is calibrated using three standards. An Initial Calibration Verification (ICV) standard is analyzed immediately after standardization, followed by an Initial Calibration Blank (ICB). The ICV is from a source other than that used for initial calibration and the ICB must be free of target analytes at and above the value to be reported or appropriate corrective action must be taken. ICP Interference Check Samples (ICSA/ICSAB) are analyzed at the frequency described in each method SOP.
	Continuing Calibration	The initial calibration is verified during the analysis sequence by analysis of a Continuing Calibration Verification (CCV) standard and a Continuing Calibration Blank (CCB). The response of the CCV must be within the SOP-specified criteria (e.g., ± 10% recovery of the true value). The CCB must be free of target analytes at or above the value to be reported or appropriate corrective action must be taken. If any ICVs/CCVs or blanks exceed their acceptance criteria, appropriate corrective action must be taken.
Atomic Absorption (GFAA/CVAA)	Initial Calibration	Initial calibration will include analysis of a calibration blank and a minimum of four (4) calibration standards covering the anticipated range of measurement. Duplicate injections are made for each concentration. Response readings, e.g., absorbance, are recorded and the resultant standard calibration curve calculated. If the SOP or program-specified criteria are not met, appropriate corrective action must be taken. An ICV standard will be analyzed immediately after standardization. The ICV must be within SOP-specified criteria (e.g., ±5% of the true value for drinking water, and ±10% in most other cases), or the initial calibration must be repeated. The ICV must be from a source other than that used for initial calibration. An ICB will be analyzed after the ICV. The ICB must be free of target analytes at and above a concentration in which sample results are reported, or corrective action must be taken.

Table 10. Minimum Instrument Calibration Procedures

Technique	Activity	Minimum Requirements
Atomic Absorption (GFAA/CVAA) (cont'd.)	Continuing Calibration	The initial calibration is verified during the analysis sequence by evaluation of a CCV standard and a CCB, as described above. The CCV value must be within SOP-specified criteria (e.g., ±10% recovery of the true value except for mercury within ±20 % of the true value). The CCB must be free of target analytes at and above the concentration reported in samples. If any ICVs/CCVs or blanks exceed their acceptance criteria, corrective action must be taken.
Inorganic Colorimetric Methods	Initial Calibration	A full initial standard calibration curve will be prepared for all colorimetric analyses on a daily basis. Working standards to define this curve will include a minimum of five (5) concentrations which cover the anticipated range of measurement, plus a calibration blank. At least one of the calibration standards will be at a concentration which will enable verification of instrument response near the reporting limit as defined in Section 8.6 or a level suitable for meeting specific program requirements. The requirement for an acceptable initial calibration is described in the analytical SOP. If the criteria are not met, appropriate corrective action must be taken. Calibration data, e.g., correlation coefficient, is entered into the laboratory notebook, or associated instrument printouts, and retained with the sample data. In lieu of a full initial curve, a daily calibration verification may be analyzed. This daily calibration will at a minimum consist of a blank and a mid-range standard. Results must be within SOP-specified criteria. If not, reanalysis of the standards may be done once to verify the readings; otherwise, a new curve will be developed. For procedures that require pretreatment steps, a minimum of one standard shall be prepared with the pretreatment. If the pre-treated standard is within SOP-specified criteria, the curve will be used. If the pre-treated sample is not within the criteria, the reason will be determined. If it is determined that the difference between the curves is inherent in the procedure, the curve will be based on the standards prepared and carried through the pretreatment. An ICV will be analyzed immediately after the standardization, followed by an ICB. The ICV must be from a source other than that used for initial calibration. The ICV must be within SOP-specified criteria and the ICB must be free of target analytes or appropriate corrective action must be taken.
	Continuing Calibration	The initial calibration is verified during the analysis sequence by analysis of a CCB and a CCV. If any ICVs/CCVs or blanks exceed their acceptance criteria, analysis is terminated, and the instrument is recalibrated. All samples since the last valid calibration verification are reanalyzed.

Table 10. Minimum Instrument Calibration Procedures

Technique	Activity	Minimum Requirements
Ion Chromatography	Initial Calibration	The ion chromatograph will be calibrated prior to each day of use. Calibration standards will be prepared from appropriate reference materials and will include a blank and a minimum of three concentrations to cover the anticipated range of measurements. At least one of the calibration standards will be at a concentration which will enable verification of instrument response near the reporting limit. If SOP-specified calibration criteria cannot be achieved, appropriate corrective action must be taken. Calibration data, e.g., correlation coefficient, will be archived with sample raw data.
	Continuing Calibration	A continuing calibration standard and blank will be analyzed at a frequency of 10% and at the end of the analysis shift. The response calculated as a percent recovery of the standard must meet SOP or program-specific criteria. The response of the blank must be less than the concentration to be reported for samples analyzed.
GC/MS	All GC/MS instrumentation is calibrated to set specifications prior to sample analysis. These specifications vary depending on the requirements of the analytical program and the designated analytical method.	
	Tuning and Mass Calibration	Mass spectrometers are calibrated with perfluorotributylamine (FC-43) or perfluorophenanthrene (FC- 5311) as required to ensure correct mass assignment. In addition, at the beginning of the daily work shift, the GC/MS system must be tuned with decafluorotriphenylphosphine (DFTPP) for semivolatiles analysis and 4-bromofluorobenzene (BFB) for volatiles analysis, and calibrated to target compounds. The majority of the laboratory work utilizes U.S. EPA-CLP or SW-846 protocols, which define the work shift as a 12-hour period initiated by the injection of DFTPP, BFB, or the dioxin/furan window mix. For drinking water programs (500 series methods), a 12-hour work shift is specified in the method for calibration frequency. For wastewater programs (600 series methods), the tune expires when the day's analytical sequence is complete; however, no time limit is given for the length of the daily GC/MS work shift. Ion abundances will be within the windows dictated by the specific program requirements.

Table 10. Minimum Instrument Calibration Procedures

Technique	Activity	Minimum Requirements
GC/MS (cont'd.)	Initial Calibration	After an instrument has been tuned, initial calibration curves (generally 3-5 points) are generated for the compounds of interest. The low level standard must be at a concentration which will enable verification of instrument response near the reporting limit or at a concentration acceptable to meet program requirements. The other standards must extend through the linear working range of the detector. The parameters requiring quantitation must meet SOP or program-specified criteria prior to initiation of sample analysis. Any sample extracts containing parameters of interest which exceed the concentration of the high level standard, must be diluted to bring the parameters within the range of the standards. Instrument response to these target compounds are evaluated against SOP-specified criteria. Linearity is verified by evaluating the response factors (RF) for the initial calibration standards against SOP-specified criteria. Once an acceptable calibration is obtained, samples may be analyzed up until the expiration of the tune. At that time, the instrument must be re-tuned prior to further analysis. After acceptable tuning, a continuing calibration standard may be analyzed in lieu of a full multi-point calibration if the SOP-specified criteria are met. The majority of compounds analyzed for GC/MS comprise EPA's Target Compound List (TCL) or Priority Pollutant List (PPL). For add-on compounds not on the current TCL or PPL, initial calibration may be performed using a single point calibration of the additional compound(s), unless prior arrangements are made for a full three-to-five point calibration. Calibration data, to include linearity verification, will be maintained in the laboratory's records of instrument calibrations.
	Continuing Calibration	During each operating shift, a single calibration standard may be analyzed to verify that the instrument responses are still within the initial calibration determinations, as defined in the specific SOPs. If criteria cannot be met, appropriate corrective action must be taken.
GC and HPLC	Gas chromatographs and high performance liquid chromatographs will be calibrated prior to use as described in analytical SOP or program requirements. Calibration standard mixtures will be prepared from appropriate reference materials and will contain analytes appropriate for the method of analysis or program requirements	
	Initial Calibration	Initial calibration will include three to five calibration standards covering the anticipated range of measurement. The low level standard must be at a concentration which will enable verification of instrument response near the reporting limit or at a concentration acceptable to meet program requirements. The other standards must extend through the linear working range of the detector. The parameters requiring quantitation must meet SOP or program-specified criteria prior to initiation of sample analysis. Any sample extracts containing parameters of interest which exceed the concentration of the high level standard, must be diluted to bring the parameters within the range of the standards.

Table 10. Minimum Instrument Calibration Procedures

Technique	Activity	Minimum Requirements
GC and HPLC (cont'd.)	Continuing Calibration	The response of the instrument will be verified for each analysis sequence by evaluation of a daily calibration verification standard at a mid-range concentration. In order to demonstrate that the initial calibration curve is still valid, the calibration check standard must be within SOP or program-specified acceptance criteria for the compounds of interest or the instrument must be recalibrated. For multi-analyte methods, this check standard may contain a representative number of target analytes rather than the full list of target compounds. Optionally, initial calibration (e.g., the full range of concentration levels) can be performed at the beginning of the analysis sequence. Within the analysis sequence, instrument drift will be monitored by analysis of a mid-range calibration standard every ten samples or 12 hour sequence (depending on the method protocol), including external QC. If the SOP or program-specified calibration criteria are not met for the compounds of interest, appropriate corrective action must be taken.

5.5 Measurement Traceability

5.5.1 General

Traceability of measurements is assured using a system of documentation, calibration, and analysis of reference standards. Laboratory equipment that are peripheral to analysis and whose calibration is not necessarily documented in a test method analysis or by analysis of a reference standard is subject to ongoing certifications of accuracy.

At a minimum, these include procedures for checking specifications for balances, thermometers, temperature, De-ionized (DI) and Reverse Osmosis (RO) water systems, automatic/eppendorf pipettes and other volumetric measuring devices. Wherever possible, subsidiary or peripheral equipment is checked against standard equipment or standards that are traceable to national or international standards [with the exception of class A glassware (including glass microliter syringes that have a certificate of accuracy)].

An external certified service engineer services laboratory balances on an annual basis. This service is documented on each balance with a signed and dated certification sticker. Balances are calibrated on each day of use (*Balance Calibration, Care and Use*; UQA-003). All thermometers and temperature monitoring devices are calibrated annually against a traceable reference thermometer. Temperature readings of ovens, refrigerators, and incubators are checked on each day of use (*Thermometer Calibrations*; UQA-034).

Laboratory DI and RO water systems have documented preventative maintenance schedules and the conductivity of the water is recorded on each day of use (*Water Quality*; UQA-035).

5.5.2 Reference Standards

The receipt of all reference standards is documented in LabNet. Standards are obtained from commercial vendors and sources may vary depending upon the availability of mixes and solutions from vendors. Each production unit is responsible to ensure, when available, that all standards are traceable to EPA, NIST, A2LA, SARMs and are accompanied by a Certificate of Analysis that documents the standard purity. If a standard cannot be purchased from a vendor that supplies a Certificate of Analysis, the purity of the standard is documented by analysis.

The receipt of each dry chemical, purchased stock solution or reference material to be used as a standard is assigned a unique ID number. The chemical name, manufacturer, lot number, date received, expiration date, date opened and initials of the analyst who opened the chemical are documented. The expiration dates for ampulated solutions shall not exceed the manufacturer's expiration date. Expiration dates for laboratory-prepared stock and diluted standards shall be no later than the expiration date of the stock solution or material or the date calculated from the holding time allowed by the applicable analytical method, whichever comes first. Expiration dates for pure chemicals shall be established by the laboratory and be based on chemical stability, possibility of contamination, and environmental and storage conditions. Expired standard materials shall be either revalidated prior to use or discarded. Revalidation may be performed through assignment of a true value and error window statistically derived from replicate analyses of the material as compared to an unexpired standard. The laboratory labels all standard and QC materials with expiration dates.

The preparation of all daughter solutions, whether a single or multiple-component stock, intermediate, or working standard solution, is documented in a standard solution preparation logbook, in a designated section of the analytical logbook or in the LabNet systems reagent program. This documentation references the Standard ID of the respective parent solution(s) used in its preparation, providing a solid trail back to the solution or chemical received from the vendor. These records include the standard name, final volume, matrix, final concentration, analyst initials, prep date and expiration date. A daughter solution should not have an expiration date which post-dates any of the parent solutions used in its preparation.

References standards are labeled with a unique Standard Identification Number, date received, and the expiration date. All documentation received with the reference standard or documentation of standard purity is retained as a QC record and references the Standard Identification Number. All efforts are made to purchase standards that are $\geq$ 97.0% purity. If this is not possible, the purity is used in performing standards calculations.

The accuracy of calibration standards is checked by comparison with a standard from a second source. In cases where a second standard manufacturer is not available, a different lot is acceptable for use as a second source. The appropriate QC criteria for specific standards are defined in laboratory SOPs. In most cases, the analysis of an ICV or LCS is used as the second source confirmation.

Storage conditions, such as shelf life, ambient or chilled, controlled or restricted access, wet or desiccated, etc.., are in conformance with the specifications set in the associated method, the program requirements, or the manufacturer's recommendation, as appropriate.

5.5.3 Reagents

Reagents are, in general, required to be analytical reagent grade unless otherwise specified in method SOPs. Reagents must be, at a minimum, the purity required in the test method. The date of reagent receipt, date the reagent was opened, and the date of reagent preparation (where applicable) are documented in LabNet for reagent traceability.

5.6 Sampling

Sample representativeness and integrity are the foundations upon which meaningful analytical results rely. Where documented and approved SAPs and/or QAPPs are in place, they must be made available to the laboratory before sample receipt, and approved by laboratory management before sample receipt.

5.7 Sample Handling, Transport, and Storage

5.7.1 General

COC can be established either when bottles are sent to the field, or at the time of sampling. STL can provide all of the necessary coolers, reagent water, sample containers, preservatives, sample labels, custody seals, COC forms, ice, and packing materials required to properly preserve, pack, and ship samples to the laboratory. Complete details for sample container preparation are contained within UCM-001. A summary of sample receipt is as follows with complete details available within the *Sample Receipt and Handling* SOP (USR-001).

Samples are received at the laboratory by the designated sample custodians and a unique LabNet job (batch) number is assigned. The following information is recorded for each sample shipment:

- Client/Project Name.
- Date and Time of Laboratory Receipt.
- Laboratory Job Number
- Signature or initials of the personnel receiving the cooler and making the entries.

Upon inspection of the cooler and custody seals, the sample custodian opens and inspects the contents of the cooler, and records the cooler temperature. If the cooler arrival temperature exceeds the required or method specified temperature range by $\pm 2^{\circ}C$ (for samples with a temperature requirement of $4^{\circ}C$, a cooler temperature of just above the water freezing temperature to $6^{\circ}C$ is acceptable); sample receipt is considered "compromised" and the procedure described in Section 4.7.1 is followed. All documents are immediately inspected to assure agreement between the test samples received and the COC.

Any non-conformance, irregularity, or compromised sample receipt as described in Section 4.7.1 is documented in an SDR and brought to the immediate attention of the Project Manager for resolution with the client. The COC, shipping documents, documentation of any non-conformance, irregularity, or compromised sample receipt, record of client contact, and resulting instructions become part of the permanent project record.

Samples that are being tested at another STL facility or by an external subcontractor are repackaged, iced, and sent out under COC.

Following sample labeling as described in Section 5.7.2, the sample is placed in storage. Refrigerated storage coolers are maintained at 4 ± 2°C. The temperature is monitored 4 times daily by an electronic monitoring software program. All samples are stored according to the requirements outlined in the test method, and in a manner such that they are not subject to cross contamination or contamination from their environment.

Access to the laboratory is restricted to laboratory personnel or escorted guests as described in Section 5.2. Therefore, once sample possession is relinquished to the laboratory, the sample is in a designated secure area (e.g., the laboratory facility) accessible only to authorized personnel. Locked storage coolers are available for protocol (e.g., AFCEE and CLP) that require internal COC procedures.

5.7.2 Sample Identification and Traceability

The sample custodian organizes the sample containers, COCs, and all pertinent information associated with the samples. The sample identity is verified against all associated sample information. Any inconsistencies are documented via an SDR and forwarded to the Project Manager for resolution with the client prior to identifying the sample(s) into LabNet.

Each sample container is assigned a unique Sample Identification Number that is cross-referenced to the client identification number such that traceability of test samples is unambiguous and documented. Each sample container is affixed with a durable sample identification label.

All unused portions of samples, including empty sample containers, are returned to the secure sample control area.

5.7.3 Sub-Sampling

Taking a representative sub-sample from a container containing a soil or solid matrix is necessary to ensure that the analytical results are representative of the sample collected in the field. The size of the sample container, the quantity of sample fitted within the container, and the homogeneity of the sample need consideration when sub-sampling for sample preparation.

After thoroughly mixing the sample within the sample container or transfer to a wip bag (or other suitable plastic bag), a sub-sample from various quadrants and depths of the sample are taken to acquire the required sample weight. Any non-homogenous looking material is avoided and noted as such within the sample preparation record.

5.7.4 Sample Preparation

Sample preparation procedures vary for each matrix and analytical method are as referenced in the laboratory SOPs.

5.7.5 Sample Disposal

Samples are retained in STL storage facilities for 30 days after the project report is sent unless prior written arrangements have been made with the client. Samples may be held longer or returned to the client per written request. Unused portions of samples are disposed of in accordance with federal, state and local regulations. Complete details on the disposal of samples, digestates, and extracts is available within the *Laboratory Waste Disposal Procedures* SOP (UWM-001).

5.8 Assuring the Quality of Test Results

5.8.1 Proficiency Testing

The laboratory analyzes Proficiency Test (PT) samples as required for accreditation and as outlined in NELAC. The laboratory participates in the PT program semi-annually for each PT field of testing for which it is accredited, according to the NELAC PT field of testing published guidelines. This includes drinking water, wastewater and solid/soil matrices.

The laboratory also participate in the Navy and Army Corps of Engineers Laboratory Assessment programs upon revalidation.

PT samples are handled and tested in the same manner (procedural, equipment, staff) as environmental samples. Results of PT samples are distributed to the laboratory line management for review and action, if required. Any required response to deficiencies are submitted to the QA department for review and are filed with the PT study records. PT test sample data is archived using the requirements for project and raw data record retention.

5.8.1.1 Double Blind Performance Evaluation

The laboratory participates in an annual double blind performance evaluation study. An external vendor is contracted to submit double blind samples to the laboratory. Both the level of customer service and the accuracy of the test results are assessed objectively by the external contractor, who provides a detailed report to the Corporate Quality Director and to the laboratory. This is administered as a double blind program in order to assess all facets of the laboratory's operations.

5.8.2 Control Samples

Control samples (e.g., QC indicators) are analyzed with each batch of samples to monitor laboratory performance in terms of accuracy, precision, sensitivity, selectivity, and interferences. Control samples must be uniquely identified and correlated to unique batches. Control samples further evaluate data based upon (1) Method Performance, which entails both the preparation and measurement steps; and (2) Matrix Effects, which evaluates field sampling accuracy, precision, representativeness, interferences, and the effect of the matrix on the method performed. Each regulatory program and each method within those programs specify the control samples that are prepared and/or analyzed with a specific batch.

Control sample types and typical frequency of their application are outlined Sections 5.8.2.1 through 5.8.2.5 and Tables 11 through 15. Note that frequency of control samples vary with

specific regulatory, methodology and project specific criteria. Complete details on method and regulatory program control samples are as listed in Sections 7 and 8 of each method SOP.

5.8.2.1 Method Performance Control Samples: Preparation Batch

Sample preparation or pre-treatment is commonly required before analysis. Typical preparation steps include homogenization, grinding, solvent extraction, sonication, acid digestion, distillation, reflux, evaporation, drying and ashing. During these pre-treatment steps, samples are arranged into discreet manageable groups referred to as preparation (prep) batches. Prep batches provide a means to control variability in sample treatment.
Control samples are added to each prep batch to monitor method performance (Table 11) and are processed through the entire analytical procedure with investigative/field samples.

Table 11. Preparation Batch Control Samples

Control Sample Type	Details	
Method Blank (MB)	Use	Monitors for potential contamination introduced during the sample preparation and analytical processes.
	Typical Frequency [1]	1 per batch of ≤ 20 samples per matrix type per sample extraction or preparation method.
	Description	Organics: Laboratory pure water for water samples or a purified solid matrix for soil or solid samples (when available or when requested); solid matrices commonly include sodium sulfate, vendor or agency supplied soil or solid, or purchased sand; these solids may require purification at the laboratory prior to use. Inorganics: Laboratory pure water for both water and soil or sediment samples. Volume/weights are selected to approximately equal the typical sample volume/weight used in sample preparation; and final results in a soil/solid batch may be calculated as mg/kg or ug/kg, assuming 100% solids and a weight equivalent to the aliquot used for the corresponding field samples, to facilitate comparison to actual field samples.
Laboratory Control Sample (LCS)	Use	Measures the accuracy of the method in a blank matrix and assesses method performance independent of potential field sample matrix affects.
	Typical Frequency [1]	1 per batch of ≤ 20 samples per matrix type per sample extraction or preparation method. For multi-analyte methods, the LCS may consist of surrogates in the blank matrix, and or a representative selection of target analytes/internal standards.
	Description	Prepared from a reference source of known concentration and processed through the preparation and analysis steps concurrently with the field samples. Aqueous LCS's may be processed for solid matrices unless a solid LCS is requested; final results may be calculated as mg/kg or ug/kg, assuming 100% solids and a weight equivalent to the aliquot used for the corresponding field samples, to facilitate comparison with the actual field samples.

Table 11. Preparation Batch Control Samples

Control Sample Type	Details	
Known QC Sample	Use	Comply with regulatory requirements; check the accuracy of an analytical procedure; troubleshoot method performance problems; verify an analyst in training's ability to accurately perform a method; to verify the return-to-control after method performance problems; and may also be used as an LCS.
	Typical Frequency [1]	As defined by the client or QAPP.
	Description	Obtained from outside suppliers or agencies; generally require preparation from concentrated materials by dilution into a standard matrix; contain known analytes or compounds; acceptance limits are provided by the vendor.

[1] Denotes an STL required frequency.

Field blanks, equipment blank and trip blanks, when received, are analyzed in the same manner as other field samples. However, a field blank should not be selected for matrix QC, as it does not provide information on the behavior of the target compounds in the field samples. Usually, the client sample ID will provide information to identify the field blanks with labels such as "FB", "EB", or "TB".

5.8.2.2 Method Performance Control Samples: Matrix

Matrix control samples include sample duplicates (MD), sample matrix spikes (MS), and sample surrogate spikes. These control samples help monitor for potential physical and chemical effects which may interfere with the precision and/or accuracy of the selected analytical method. Since interferences can enhance or mask the presence of target analytes, matrix control samples measure the degree of interference and are used to assist in the interpretation of the analytical results. The laboratory avoids performing matrix QC on known field blank samples, such as trip blanks and rinsates, since these samples are not indicative of the sample matrix.

Table 12. Matrix Control Samples

Control Sample Type	Details	
Matrix Duplicate (MD)	Use	Monitors the effect of site matrix on the precision of the method; and of the reproducibility of laboratory preparation and measurement techniques. **Note:** Precision may also be affected by the degree of homogeneity of the sample, particularly in the case of non-aqueous samples or aqueous samples with particulates. Sample homogeneity and matrix effect should be considered when field samples are used to assess reproducibility. **Note:** A field duplicate, when received, measures Representativeness of sampling and the effect of the site matrix upon precision.

Table 12. Matrix Control Samples

Control Sample Type	Details	
Matrix Duplicate (MD) (cont'd.)	Typical Frequency [1]	1 per 20 samples per matrix or per SAP/QAPP [2].
	Description	Performed by analyzing two aliquots of the same field sample independently; analyzed for each associated sample matrix (e.g., when requested by the client or the analytical method).
Matrix Spike (MS)	Use	Measures the effect of site sample matrix on the accuracy of the method.
	Typical Frequency [1]	1 per 20 samples per matrix or per SAP/QAPP.
	Description	Aliquot of a field sample which is spiked with the analytes or compounds of interest; analyzed for each associated sample matrix (when requested by the client or analytical method). The determination of MS percent recovery (% R) requires an analysis of a fortified sample and a non-fortified sample under the same procedural conditions (e.g., sample volumes, dilutions, procedural conditions, etc..). The concentration determined in the non-fortified sample is subtracted from the fortified sample concentration before determining the %R. The degree of homogeneity of the sample, particularly in the case on non-aqueous samples or samples with particulates, may affect the ability to obtain representative recoveries.
Matrix Spike Duplicate (MSD)	Use	Measures effect of site sample matrix on precision of method.
	Typical Frequency [1]	1 per 20 samples per matrix, when requested by the client or the analytical method, or per SAP/QAPP [2].
	Description	Alternative to sample duplicate. Generally, inorganic protocols specify an MD/MS and organic protocols specify an MS/MSD.
Surrogate Spike	Use	Measures method performance to sample matrix (organics only).
	Typical Frequency [1]	Every QC and analytical sample.
	Description	Compounds similar to the target analytes in structure, composition and chromatography, but not typically found in the environment, are added to each QC and analytical sample, prior to preparation (e.g., extraction). If the surrogates in an analytical batch do not all conform to established control limits, the pattern of conformance in investigative and control samples is examined to determine the presence of matrix interference or the need for corrective action.
Internal Standards	Use	Monitor the qualitative aspect of organic and inorganic analytical measurements.
	Typical Frequency [1]	All organic and ICP methods as required by the analytical method.
	Description	Used to correct for matrix effects and to help troubleshoot variability in analytical response and are assessed after data acquisition. Possible sources of poor internal standard response are sample matrix, poor analytical technique or instrument performance.

[1] Denotes an STL required frequency.
[2] Either an MSD or an MD is required per 20 samples per matrix or per SAP/QAPP.

5.8.2.3 Matrix QC Frequencies

The frequency of matrix QC indicators depends on regulatory program compliance, a project's data quality objectives, or a client's requirements. The following frequency will be applied to samples when the regulatory programs are known and it does not conflict with project or client requirements.

Table 13. EPA Program Requirements

Program	Description [1]
SDWA	MD performed at a 10% frequency or 1 per preparation batch of ≤10 samples, whichever is more frequent.
CWA	MS (GC methods) and MD is performed at a 10% frequency or 1 per preparation batch of ≤10 samples, whichever is more frequent. For GC/MS Methods, MS is performed at a 5% frequency or 1 per preparation batch of ≤20 samples, whichever is more frequent.
RCRA	MS/MSD or MS/MD is performed at a rate of 5% per client (independent of the preparation batch). For clients submitting less than 10 samples, the method matrix QC requirement may be satisfied by another clients sample within the same prep batch unless the paperwork indicates a client requirement for matrix QC. Matrix QC will only be reported to the client who owns the data.
U.S. EPA CLP	MS/MSD or MS/MD is performed at a rate of 5% or 1 set per Sample Delivery Group (SDG) per matrix, independent of the prep batch. For NFESC samples, samples are processed in simultaneous or continuous batches.

[1] MS, MSD and MD may not be applicable to some analytical protocols because of the nature of the sample or protocol.

5.8.2.4 Method Performance Control Samples: Instrument Measurement

Control samples are used to ensure that optimum instrument performance is achieved. These samples help ensure that the proper identification and quantitation of target compounds or analytes are achieved. The instrument control samples appropriate to each analytical technique are described in laboratory SOPs for each respective method. A brief description of these checks is included in Table 14.

Table 14. Instrument Performance Control Samples

Control Sample Type	Description	
Inorganics		
ICV	Use	Calibration standard of known concentration prepared from a source other than that used for the calibration standards.
	Sequence	Analyzed after the standard curve to confirm calibration.
ICB	Use	Blank water or solvent; confirms the calibration and assures that any potential contamination is less than the reporting limit.
	Sequence	Analyzed immediately after the ICV.

Table 14. Instrument Performance Control Samples

Control Sample Type	Description	
ICP Interference Check Samples (ICSA/ICSB)	Use	Verifies the absence of spectral interferences.
	Sequence	Analyzed consecutively at the beginning of each eight hour analytical sequence, after the ICV/ICB, and again at an eight hour frequency following a CCV/CCB. When CLP protocols are followed, the ICSA/B will be analyzed with the analytical sequence, before the final CCV/CCB.
Reporting Limit Verification Standard (CRA and CRI)	Use	Verifies linearity near the reporting limit for CLP metals analyses. (Note: CRI is at a level 2X the CRDL; CRA is near the CRDL).
	Sequence	Analyzed after the ICB. The CRI is also analyzed at the end of the eight hour analytical sequence, prior to analysis of the final CCV/CCB.
CCV	Use	Confirm that the instrument performance has not significantly changed during the analytical sequence; to verify stable calibration throughout the sequence; and/or to demonstrate that instrument response did not drift over a period of non-use. Made from a source other than that used for the standard curve.
	Sequence	Analyzed at 10% or every two hours, whichever is more frequent; also analyzed at the end of the analytical sequence.
CCB	Use	Water blank used to confirm that the baseline has not drifted and to monitor for contamination at the reporting limit.
	Sequence	Analyzed at a rate of 10% for inorganics and at a rate of 1 per 10 readings/injections or every two hours, whichever is more frequent, for CLP metals; also analyzed at the end of the analytical sequence.
ICP Metals Linear Range	Use	Verify linearity and document the upper limit of the calibration range for each element.
Analysis Standard (LRS)	Sequence	Performed quarterly with a blank and a minimum of five standard concentrations to cover the anticipated range of measurement; one of the calibration standards will be at or near the reporting limit. The calibration curve generated must have a correlation coefficient $\geq$ 0.995 in order to consider the responses linear over that range.
ICP Inter-Element Correction (IEC)	Use	Correction factors for spectral interference (particularly due to Al, Ca, Fe, and Mg).
	Sequence	Determined at least annually for all wavelengths used for each analyte reported by ICP; or any time the ICP is adjusted in any way that may affect the IECs.
		Organics
GC/MS Tuning & Performance	Use	Ensures correct mass assignment and is monitored through response to target compounds during initial and continuing calibration, with minimum response criteria for specified system performance check compounds (SPCCs), and linearity is verified by evaluating the response factors (RF) for calibration check compounds (CCCs).

Table 14. Instrument Performance Control Samples

Control Sample Type	Description	
GC/MS Tuning & Performance (cont'd.)	Sequence	Tuned at the beginning of the daily work shift. Throughout the analysis, blanks, internal standard areas, surrogates, chromatographic baseline, resolution of peaks, and overall quality of the chromatography are used collectively to monitor instrument performance.
GC & HPLC Instrument Performance	Use	Monitored through retention time shift evaluation, linearity checks, and degradation checks of selected target compounds (e.g., for Endrin or DDT as appropriate).
	Sequence	Continuing calibration verification (e.g., blanks, shifts in chromatographic baseline or retention times, resolution of peaks, and overall quality of the chromatography) throughout the analytical sequence is accomplished through analysis of calibration check standards.

5.8.2.5 Method Performance Control Samples: Analysis Batch

Matrix specific control samples are used to assess the precision and accuracy of the method as applied to the specific sample matrix. These indicators provide information on sample matrix effects that is independent of the efficiency of the preparatory technique. The method performance control samples appropriate to each analytical technique are identified in the respective method. A brief description of these checks is included in Table 15.

These control samples are performed to provide a tool for evaluating how well the method performed for the respective matrix. These values are used by the client to assess the validity of a reported result within the context of the project's data quality objectives. For matrix specific QC results falling outside laboratory control limits which are attributed to matrix affects, no systematic corrective action is taken.

Table 15. Analysis Batch Performance Control Samples

Control Sample Type	Description	
ICP Serial Dilution	Use	5X Dilution of a field sample (performed at the instrument) to check for possible physical and/or chemical interferences.
	Sequence	5% of field samples or 1 per ≤20 samples per batch.
GFAA Analytical Bench Spike	Use	Required by the method; prepared at the instrument by fortifying the digestate with a known quantity of the analyte of interest.
	Sequence	Performed on each sample immediately following the unspiked original analysis.
Method of Standard Addition (MSA)	Use	When specified by the analytical protocol or by client request.
	Sequence	When specified by the analytical protocol or by client request.

5.8.3 Statistical Control Limits and Charts

Statistical control limits and control charts are used to establish method performance of a given analysis and to monitor trends of QC results graphically over time. Once a data base of the laboratory results for a method/matrix/QC analyte combination is established, the acceptability of a given analysis of that QC parameter (and of the analytical batch to which it belongs) can be evaluated in light of the laboratory's normal performance. This is intended to help identify problems before they might affect data. Often, patterns of response that are not at all evident in sets of numbers are very distinct when the same values are viewed as a chronological graph.

Establishment of Limits

The purpose of using statistical control limits is to define, for each analyte in a given method/matrix/QC type combination, a range of expected values. This range encompasses the random variation that occurs normally in the laboratory and allows one to evaluate control samples in that context, rather than according to an arbitrary or external set of values. Limits for accuracy and precision are defined below:

Accuracy

As recoveries of a QC analyte in a given matrix are tabulated over time, a mean value for recovery is established, as is the standard deviation (s) of those recoveries. If the analysis is in statistical control (e.g., if the set of QC recoveries over time show random variation about the mean) approximately 99.7% of all recoveries for that QC will fall within three standard deviations (3s) of the mean. Thus, assuming that the mean itself is an acceptable level of recovery, the values corresponding to 3s above and 3s below the mean are defined as the Control Limits. Any single recovery outside these values is assumed to have resulted from some circumstance other than normal variation and shall be investigated.

Roughly 95% of points should fall within 2s of the mean. The values +2s and -2s are the Warning Limits. Any normal result has approximately a 1/20 chance of being between 2s and 3s from the mean, so a result in this region doesn't necessarily warrant corrective action, but attention should be paid to such points.

Precision

Precision is used to indicate matrix variability so that appropriate decisions can be made by the client when repeated analyses vary significantly. The coefficient of variation, expressed as a percentage (e.g., the %RSD) for the data set used to calculate accuracy control limits defines the control limit for precision. Duplicate analyses of the QC samples, such as duplicates or MS/MSD, should have an RPD less than or equal to this established precision control limit to be considered free of matrix interferences.

The laboratory calculates statistical control limits on an annual basis. Such limits are available on a project or QAPP-specific basis.

5.8.4 Calibration

Calibration protocols are method-specific, are briefly described in Table 10 and are defined in the Sections 6 & 7 of the method SOPs.

5.8.5 Glassware Cleaning

All glassware is thoroughly cleaned prior to use to ensure that sample integrity is not affected from artifacts caused by contaminated glassware.

A summary of general cleaning procedures follows with details provided in the *Laboratory Glassware Cleaning* SOP (UQA-009):

General laboratory glassware is cleaned with a low- or non-phosphate detergent, followed by thorough rinsing with tap water and deionized water.
Volumetric flasks and pipettes used for inorganics (method dependent), test tubes and caps used for micro-COD procedures, phosphate glassware, and metals-related glassware include an acid-washing step.

BOD glassware cleaning includes a nitric or sulfuric acid and/or a NOCHROMIX-washing step.
Organic glassware includes a solvent-wash.
Non-volumetric organic glassware may optionally be kiln dried at 400°C.

5.8.6 Permitting Departures from Documented Procedure

Where a departure from a documented SOP, test method, or policy is determined to be necessary, or unavoidable, the departure is documented in a CAR or SDR and reported in the case narrative. In most cases, these departures can be made with the approval of the section manager, project manager and the client. Issues of serious concern, as determined by the Section Manager or Project Manager, will be brought to the attention of the Laboratory Manager and/or QA Manager. In some instances, it is appropriate to inform the client before permitting a departure. The Project Manager will make the determination as to the degree of notification required by the client.

On rare occasions, special analytical techniques will be requested for research, project specific requirements, or client needs. In these instances, SOPs may not be available, however, the analyst will thoroughly record the analytical steps and observations within a bound preformatted logbook.

5.8.7 Development of QC Criteria, Non-Specified in Method/Regulation

Where a method or regulation does not specify acceptance and/or rejection criteria, the laboratory must examine the data user's needs and the demonstrated sensitivity, accuracy and precision of the available test methods in determining appropriate QC criteria.

Data users often need the laboratory's best possible sensitivity, accuracy, and precision using a routinely offered test method, or are unsure of their objectives for the data. For routine test methods that are offered as part of STL's standard services, the laboratory bases the QC criteria on statistical information such as determination of sensitivity, historical accuracy and precision data, and method verification data. The method SOP includes QC criteria for ongoing demonstration that the established criteria are met (e.g., acceptable LCS accuracy ranges, precision requirements, method blank requirements, initial and continuing calibration criteria, etc..).

In some cases, a routine test method may be far more stringent than a specific data user's needs for a project. The laboratory may either use the routinely offered test method, or may opt to

develop an alternate test method based on the data user's objectives for sensitivity, accuracy, and precision. In this case, it can be appropriate to base the QC criteria on the data user's objectives, and demonstrate through method verification and ongoing QC samples that these objectives are met.

For example, a client may require that the laboratory to test for a single analyte with specific DQOs for sensitivity, accuracy, and precision as follows: Reporting Limit of 10 ppm, Accuracy ±25%, and RSD of <30%. The laboratory may opt to develop a method that meets these criteria and document through the Method Blank results, MDL study, and LCS results that the method satisfies those objectives. In this case, both the method and the embedded QC criteria have been based on the client's DQOs.

In some cases, the data user needs more stringent sensitivity, accuracy, and/or precision than the laboratory can provide using a routine test method. In this case, it is appropriate that the laboratory provide documentation of the sensitivity, accuracy, and precision obtainable to the data user and let the data user determine whether to use the best available method offered by the laboratory, or determine whether method development or further research is required.

5.9 Project Reports

The SOP for data package assembly and reporting formats is UDM-001 and a summary of this procedure follows.

Analytical reports comprise final results (uncorrected for blanks and recoveries unless specified), methods of analysis, levels of reporting, surrogate recovery data, and method blank data. In addition, special analytical problems will be noted in the case narratives. The number of significant figures reported are consistent with the limits of uncertainty inherent in the analytical method. Consequently, most analytical results will be reported to no more than two (2) or three (3) significant figures. Data are normally reported in units commonly used for the analyses performed.

Concentrations in liquids are expressed in terms of weight per unit volume (e.g., milligrams per liter, mg/L). Concentrations in solid or semi-solid matrices are expressed in terms of weight per unit weight of sample (e.g., micrograms per kilograms, ug/kg). Reporting limits take into account all appropriate concentration, dilution, and/or extraction factors, unless otherwise specified by program requirements (e.g., IRPMS reports).

A client report is generated with various steps of approval prior to printing of the final version. If any analytical anomalies were encountered during the analyses, e.g., an out-of-control matrix duplicate, it is documented in a case narrative. The case narrative is prepared by the respective operating unit and submitted to the data management section to insert in the final report.

The final report forms are printed, data packages are organized, a glossary of flags and acronyms is added, and reports are paginated.

5.9.1 General

The criteria described in Section 5.9.2 apply to all Project Reports that are generated under NELAC requirements. The criteria described in Section 5.9.3 and 5.9.4 apply to all Project Reports.

5.9.2 Project Report Content

- Title
- Laboratory name, address, telephone number, contact person
- Unique Laboratory Project Number
- Name and Address of Client
- Client Project Name (if applicable)
- Laboratory Sample Identification
- Client Sample Identification
- Matrix and/or Description of Sample
- Dates: Sample Receipt, Collection, Preparation and/or Analysis Date
- Definition of Data Qualifiers
- Reporting Units
- Test Methods
- Report Paginated

The following are required where applicable to the specific test method or matrix:

- Solid Samples: Indicate Dry or Wet Weight
- Whole Effluent Toxicity: Statistical package used
- If holding time $\leq$ 48 hours, Sample Collection, Preparation and/or Analysis Time
- Indication by flagging where results are reported below the quantitation limit.

5.9.3 Project Narrative

A Project Narrative and/or Cover Letter is included with each project report and, at a minimum, includes an explanation of any and all of the following occurrences:

- Non-conformances
- "Compromised" sample receipt (see Section 4.7.1)
- Method Deviations
- QC criteria failures

Project Release

The Project Manager or his designee authorizes the release of the project report with a signature.

Where amendments to project reports are required after issue, these are documented in the form of an RDR (refer to Section 4.8) and can be in the form of a separate document and/or electronic data deliverable resubmittal. The revised report is clearly identified as revised with the date of revision and the initials of the person making the revision. Specific pages of a project report may be revised using the above procedure with an accompanying cover letter indicating the page

numbers of the project revised. The original version of the project report will be kept intact and the revisions and cover letter included in the project files.

5.9.4 Subcontractor Test Results

Subcontracted data is clearly identified as such, and the name, address, and telephone number for the laboratory performing the test is included in the project report. Subcontracted results from laboratories external to STL are not reported on STL report forms or STL letterhead. Test results from more than one STL facility are clearly identified with the name of the STL facility that performed the testing, address, and telephone number for that facility. Data from subcontractors' reports may be added to an STL electronic deliverable.

Data subcontracted within STL may be reported on the originating laboratory's report forms provided the following mandatory requirements are met:

- The name, address, and telephone number of the facility are provided.
- Analytical results produced by the STL intra-company subcontractor are clearly identified as being produced by the subcontractor facility.
- The intra-company subcontractor's original report, including the chain of custody is retained by the originating laboratory.
- Proof of certification is retained by the originating laboratory.
- All information as outlined in Section 5.9.2 is included in the final report where the report is required to be compliant with NELAC, for both the originating and subcontracting laboratory.

5.9.5 Electronic Data Deliverables

Electronic Data Deliverables (EDD) are routinely offered as part of STL's services. STL offers a variety of EDD formats including Environmental Restoration Information Management System (ERPIMS), New Agency Standard (NAS), Format A, Excel, Dbase, GISKEY, and Text Files.

EDD specifications are submitted to the IT department by the Project Manager for review and undergo the contract review process in Section 4.4.1. Once the laboratory has committed to providing diskettes in a specific format, the coding of the format may need to be performed. This coding is documented and validated. The validation of the code is retained as a QC record. EDDs are subject to a secondary review to ensure their accuracy and completeness.

5.9.6 Project Report Format

STL offers a wide range of project reporting formats, including EDDs, short report formats, and complete data deliverable packages modeled on the Contract Laboratory Protocol (CLP) guidelines. More information on the range of project reports available in the Data Management SOP (UDM-001). Regardless of the level of reporting, all projects undergo the levels of review as described in Section 5.3.6.

Appendix. List of Cited SOPs and Work Instructions

Cited Section No(s).	Description	Document No.
1.6 5.7.1	Container Management: Process Operation	UCM-001
1.6 4.4.2	Project Management: Project Planning Process	UPM-003
4.1	Signature Authority	UQA-030
4.1.1	Work Instruction: Equipment & Instrumentation Listing	CHI-22-09-103
4.1.2.5	Sample Management: Subcontracting Processes	USM-001
4.1.2.9	Computer System Account and Naming Policy Password Policy Software Licensing Virus Protection Policy	P-I-003 P-I-004 P-I-005 P-I-006
4.12.2	Work Instruction: Records Management Form	CHI-22-05-032
4.3.1	Document Control	UQA-006
4.3.1.1 5.3.2	Approved SOP Listing	CHI-22-09-SOP List
4.3.2 4.12.3	Data Management: Record Retention & Purging	UDM-002
4.4.2	Project Kick-Off Meetings	UPM-002
4.6	Procurement Quality Assurance Process	UQA-020
4.6.1	Testing Solvents and Acids	S-T-001
4.7.2	Client Confidentiality	UQA-004
4.8 4.11	Sample Discrepancy Reports (SDRs) / Resubmitted Data Reports (RDRs) / Corrective Action Reports (CARs)	UQA-029
4.8 4.11	Quality Systems Management Review	UQA-002
4.11	Preventive Action Measures	UQA-019
4.13	Internal Audits	UQA-013
5.1.2	Training Program: Mechanisms and Documentation Processes Defined by Operational Assessment	UQA-014
5.3.1	Work Instruction: Methods Capabilities	CHI-22-09-255
5.3.2	SOP Change Protocol	UQA-032
5.3.5	Method Detection Limits (MDLs)	UQA-017
5.3.6.1	Acceptable Manual Integration Practices	S-Q-004
5.3.6.2	Data Review Checklists GC Extractables / HPLC GC Volatiles GC/MS: Volatiles and Semi-Volatiles Metals Wet Chemistry	 CHI-22-17-034 CHI-22-19-003 CHI-22-20-038 CHI-22-14-004; 5; 6 CHI-22-12-096
5.4.1	Work Instruction: Equipment Tracking Form	CHI-22-09-068
5.4.2	Instrument and Equipment Out-of-Service Tagging.	UQA-012
5.4.3	Selection of Calibration Points	P-T-001
5.5.1	Balance Calibration, Care and Use	UQA-003
5.5.1	Thermometer Calibrations	UQA-034
5.5.1	Water Quality	UQA-035

Appendix. List of Cited SOPs and Work Instructions

Cited Section No(s).	Description	Document No.
5.7.1	Sample Receipt: Handling and Processing	USR-001
5.7.5	Laboratory Waste Disposal Procedures	UWM-001
5.8.5	Glassware Cleaning Procedures	UQA-009
5.9 5.9.6	Data Management: Process Operation	UDM-001

ATTACHMENT 2
STL Laboratory
Method Precision/Accuracy Objectives

STL Chicago
Method Limit Report

Project:
Updated: 3/4/02

Filter	Method Description	Analytical Method	Test Matrix	Units	MDL	Lab RL	LCL	UCL	RPD	SLL	SUL
x	**Method: Metals Analysis (ICAP Trace) (6010TR)**										
x	Arsenic	6010B	Water	mg/L	0.0053	0.01	80	120	20		
x	Barium	6010B	Water	mg/L	0.0028	0.01	80	120	20		
x	Cadmium	6010B	Water	mg/L	0.0003	0.002	80	120	20		
x	Chromium	6010B	Water	mg/L	0.003	0.01	80	120	20		
x	Lead	6010B	Water	mg/L	0.0047	0.005	80	120	20		
x	Selenium	6010B	Water	mg/L	0.0049	0.01	80	120	20		
x	Silver	6010B	Water	mg/L	0.0013	0.005	80	120	20		
x	**Method: Metals Analysis (ICAP Trace) (6010TR)**										
x	Arsenic	6010B	Solid	mg/Kg	0.38	1	80	120	20		
x	Barium	6010B	Solid	mg/Kg	0.092	1	80	120	20		
x	Cadmium	6010B	Solid	mg/Kg	0.099	0.2	80	120	20		
x	Chromium	6010B	Solid	mg/Kg	0.16	1	80	120	20		
x	Lead	6010B	Solid	mg/Kg	0.38	0.5	80	120	20		
x	Selenium	6010B	Solid	mg/Kg	0.46	1	80	120	20		
x	Silver	6010B	Solid	mg/Kg	0.19	0.5	80	120	20		
x	**Method: Mercury (CVAA) (7470)**										
x	Mercury	7470	Water	ug/L	0.065	0.2	80	120	20		
x	**Method: Mercury (CVAA) Solids (7471)**										
x	Mercury	7471	Solid	ug/Kg	5.4	33	80	120	20		

STL Chicago
Method Limit Report

Project:
Updated: 3/4/02

Filter	Method Description	Analytical Method	Test Matrix	Units	MDL	Lab RL	LCL	UCL	RPD	SLL	SUL
x	**Method: Organochlorine Pesticide Analysis (8081)**										
x	4,4'-DDD	8081A	Water	ug/L	0.026	0.05	66	134	20		
x	4,4'-DDE	8081A	Water	ug/L	0.023	0.05	70	123	20		
x	4,4'-DDT	8081A	Water	ug/L	0.0076	0.05	71	134	20		
x	Aldrin	8081A	Water	ug/L	0.0065	0.025	67	114	20		
x	alpha-BHC	8081A	Water	ug/L	0.0041	0.025	66	119	20		
x	alpha-Chlordane	8081A	Water	ug/L	0.0053	0.025	73	122	20		
x	beta-BHC	8081A	Water	ug/L	0.016	0.025	68	107	20		
x	delta-BHC	8081A	Water	ug/L	0.0095	0.025	78	116	20		
x	Dieldrin	8081A	Water	ug/L	0.01	0.05	70	132	20		
x	Endosulfan I	8081A	Water	ug/L	0.0036	0.025	73	115	20		
x	Endosulfan II	8081A	Water	ug/L	0.019	0.05	70	113	20		
x	Endosulfan sulfate	8081A	Water	ug/L	0.014	0.05	72	117	20		
x	Endrin	8081A	Water	ug/L	0.014	0.05	68	132	20		
x	Endrin aldehyde	8081A	Water	ug/L	0.046	0.05	69	145	20		
x	Endrin ketone	8081A	Water	ug/L	0.011	0.05	72	119	20		
x	gamma-BHC (Lindane)	8081A	Water	ug/L	0.0037	0.025	67	113	20		
x	gamma-Chlordane	8081A	Water	ug/L	0.0055	0.025	74	110	20		
x	Heptachlor	8081A	Water	ug/L	0.0035	0.025	64	121	20		
x	Heptachlor epoxide	8081A	Water	ug/L	0.0055	0.025	65	119	20		
x	Methoxychlor	8081A	Water	ug/L	0.16	0.25	69	146	20		
x	Toxaphene	8081A	Water	ug/L	0.14	0.5					
x	**Surrogate**										
x	Decachlorobiphenyl (surr)	8081A	Water	ug/L						20	100
x	Tetrachloro-m-xylene (surr)	8081A	Water	ug/L						20	123

STL Chicago
Method Limit Report

Project:
Updated: 3/4/02

Filter	Method Description	Analytical Method	Test Matrix	Units	MDL	Lab RL	LCL	UCL	RPD	SLL	SUL
x	**Method: Organochlorine Pesticide Analysis (8081)**										
x	4,4'-DDD	8081A	Solid	ug/Kg	0.36	1.7	66	132	20		
x	4,4'-DDE	8081A	Solid	ug/Kg	0.65	1.7	66	126	20		
x	4,4'-DDT	8081A	Solid	ug/Kg	0.37	1.7	65	137	20		
x	Aldrin	8081A	Solid	ug/Kg	0.13	0.83	66	116	20		
x	alpha-BHC	8081A	Solid	ug/Kg	0.16	0.83	69	121	20		
x	alpha-Chlordane	8081A	Solid	ug/Kg	0.12	0.83	71	121	20		
x	beta-BHC	8081A	Solid	ug/Kg	0.15	0.83	60	112	20		
x	delta-BHC	8081A	Solid	ug/Kg	0.11	0.83	68	125	20		
x	Dieldrin	8081A	Solid	ug/Kg	0.34	1.7	65	135	20		
x	Endosulfan I	8081A	Solid	ug/Kg	0.27	0.83	66	120	20		
x	Endosulfan II	8081A	Solid	ug/Kg	0.28	1.7	64	118	20		
x	Endosulfan sulfate	8081A	Solid	ug/Kg	0.29	1.7	68	119	20		
x	Endrin	8081A	Solid	ug/Kg	0.43	1.7	67	126	20		
x	Endrin aldehyde	8081A	Solid	ug/Kg	0.33	1.7	72	135	20		
x	Endrin ketone	8081A	Solid	ug/Kg	0.29	1.7	61	137	20		
x	gamma-BHC (Lindane)	8081A	Solid	ug/Kg	0.23	0.83	65	118	20		
x	gamma-Chlordane	8081A	Solid	ug/Kg	0.15	0.83	68	116	20		
x	Heptachlor	8081A	Solid	ug/Kg	0.18	0.83	66	127	20		
x	Heptachlor epoxide	8081A	Solid	ug/Kg	0.14	0.83	65	118	20		
x	Methoxychlor	8081A	Solid	ug/Kg	2.3	8.3	66	150	20		
x	Toxaphene	8081A	Solid	ug/Kg	4.6	16.7					
x	**Surrogate**										
x	Decachlorobiphenyl (surr)	8081A	Solid	ug/Kg						20	158
x	Tetrachloro-m-xylene (surr)	8081A	Solid	ug/Kg						20	155

STL Chicago
Method Limit Report

Project:
Updated: 3/4/02

Filter	Method Description	Analytical Method	Test Matrix	Units	MDL	Lab RL	LCL	UCL	RPD	SLL	SUL
x	**Method: PCB Analysis (8082)**										
x	Aroclor 1016	8082	Water	ug/L	0.15	0.50	65	103	20		
x	Aroclor 1221	8082	Water	ug/L	0.19	0.50					
x	Aroclor 1232	8082	Water	ug/L	0.12	0.50					
x	Aroclor 1242	8082	Water	ug/L	0.19	0.50					
x	Aroclor 1248	8082	Water	ug/L	0.2	0.50					
x	Aroclor 1254	8082	Water	ug/L	0.15	0.50					
x	Aroclor 1260	8082	Water	ug/L	0.061	0.50	52	112	20		
x	**Surrogate**										
x	Decachlorobiphenyl (surr)	8082	Water	ug/L						20	100
x	Tetrachloro-m-xylene (surr)	8082	Water	ug/L						20	123
x	**Method: PCB Analysis (8082)**										
x	Aroclor 1016	8082	Solid	ug/Kg	2.4	16.7	66	104	20		
x	Aroclor 1221	8082	Solid	ug/Kg	6.9	16.7					
x	Aroclor 1232	8082	Solid	ug/Kg	3.9	16.7					
x	Aroclor 1242	8082	Solid	ug/Kg	5.7	16.7					
x	Aroclor 1248	8082	Solid	ug/Kg	3.9	16.7					
x	Aroclor 1254	8082	Solid	ug/Kg	2	16.7					
x	Aroclor 1260	8082	Solid	ug/Kg	1.6	16.7	68	108	20		
x	**Surrogate**										
x	Decachlorobiphenyl (surr)	8082	Solid	ug/Kg						24	154
x	Tetrachloro-m-xylene (surr)	8082	Solid	ug/Kg						25	138

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Filter	Method Description	Analytical Method	Test Matrix	Units	MDL	Lab RL	LCL	UCL	RPD	SLL	SUL
x	**Method: Semivolatile Organics (8270)**										
x	1,2,4-Trichlorobenzene	8270C	Water	ug/L	5.7	10	45	100	20		
x	1,2-Dichlorobenzene	8270C	Water	ug/L	5.4	10	36	100	20		
x	1,3-Dichlorobenzene	8270C	Water	ug/L	5.7	10	38	100	20		
x	1,4-Dichlorobenzene	8270C	Water	ug/L	5.8	10	38	100	20		
x	2,2-oxybis (1-chloropropane)	8270C	Water	ug/L	4.2	10	35	107	20		
x	2,4,5-Trichlorophenol	8270C	Water	ug/L	3.6	50	54	107	20		
x	2,4,6-Trichlorophenol	8270C	Water	ug/L	2.8	10	51	101	20		
x	2,4-Dichlorophenol	8270C	Water	ug/L	4.3	10	52	100	20		
x	2,4-Dimethylphenol	8270C	Water	ug/L	4.6	10	35	100	20		
x	2,4-Dinitrophenol	8270C	Water	ug/L	12	50	40	125	20		
x	2,4-Dinitrotoluene	8270C	Water	ug/L	3.1	10	56	115	20		
x	2,6-Dinitrotoluene	8270C	Water	ug/L	3	10	57	110	20		
x	2-Chloronaphthalene	8270C	Water	ug/L	3.6	10	53	100	20		
x	2-Chlorophenol	8270C	Water	ug/L	4.4	10	43	100	20		
x	2-Methylnaphthalene	8270C	Water	ug/L	4.3	10	48	119	20		
x	2-Methylphenol (o-cresol)	8270C	Water	ug/L	5	10	37	100	20		
x	2-Nitroaniline	8270C	Water	ug/L	4	50	50	112	20		
x	2-Nitrophenol	8270C	Water	ug/L	4.3	10	48	100	20		
x	3,3-Dichlorobenzidine	8270C	Water	ug/L	4.4	20	30	104	20		
x	3-Nitroaniline	8270C	Water	ug/L	3.5	50	50	109	20		
x	4,6-Dinitro-2-methylphenol	8270C	Water	ug/L	6.4	50	56	125	20		
x	4-Bromophenyl phenyl ether	8270C	Water	ug/L	2.9	10	54	112	20		
x	4-Chloro-3-methylphenol	8270C	Water	ug/L	3.8	10	50	105	20		
x	4-Chloroaniline	8270C	Water	ug/L	2.7	10	38	114	20		
x	4-Chlorophenyl phenyl ether	8270C	Water	ug/L	3.6	10	58	103	20		
x	4-Methylphenol (m/p-cresol)	8270C	Water	ug/L	3.8	10	35	106	20		
x	4-Nitroaniline	8270C	Water	ug/L	6.1	50	40	124	20		
x	4-Nitrophenol	8270C	Water	ug/L	7.1	50	30	116	20		
x	Acenaphthene	8270C	Water	ug/L	3.1	10	58	102	20		
x	Acenaphthylene	8270C	Water	ug/L	3.2	10	56	102	20		
x	Anthracene	8270C	Water	ug/L	2.5	10	56	106	20		
x	Benzidine	8270C	Water	ug/L	64	100	10	100	20		
x	Benzo(a)anthracene	8270C	Water	ug/L	2.5	10	52	110	20		
x	Benzo(a)pyrene	8270C	Water	ug/L	3.7	10	40	129	20		
x	Benzo(b)fluoranthene	8270C	Water	ug/L	3.6	10	54	129	20		
x	Benzo(ghi)perylene	8270C	Water	ug/L	4.3	10	38	144	20		
x	Benzo(k)fluoranthene	8270C	Water	ug/L	3.7	10	48	126	20		
x	Benzoic acid	8270C	Water	ug/L	6.5	50	27	111	20		
x	Benzyl alcohol	8270C	Water	ug/L	4.7	10	41	105	20		
x	Bis(2-chloroethoxy)methane	8270C	Water	ug/L	4.8	10	48	106	20		
x	Bis(2-chloroethyl)ether	8270C	Water	ug/L	4.8	10	42	100	20		

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Filter	Method Description	Analytical Method	Test Matrix	Units	MDL	Lab RL	LCL	UCL	RPD	SLL	SUL
x	Bis(2-ethylhexyl)phthalate	8270C	Water	ug/L	6	10	54	113	20		
x	Butyl benzyl phthalate	8270C	Water	ug/L	5	10	52	111	20		
x	Carbazole	8270C	Water	ug/L	2.8	10	49	104	20		
x	Chrysene	8270C	Water	ug/L	3	10	53	105	20		
x	Dibenzo(a,h)anthracene	8270C	Water	ug/L	3.6	10	42	141	20		
x	Dibenzofuran	8270C	Water	ug/L	3.4	10	57	100	20		
x	Diethyl phthalate	8270C	Water	ug/L	4.1	10	55	107	20		
x	Dimethyl phthalate	8270C	Water	ug/L	3.1	10	58	104	20		
x	Di-n-butyl phthalate	8270C	Water	ug/L	3.5	10	55	113	20		
x	Di-n-octyl phthalate	8270C	Water	ug/L	4.3	10	31	152	20		
x	Fluoranthene	8270C	Water	ug/L	4.5	10	51	111	20		
x	Fluorene	8270C	Water	ug/L	4	10	56	104	20		
x	Hexachlorobenzene	8270C	Water	ug/L	2.8	10	50	113	20		
x	Hexachlorobutadiene	8270C	Water	ug/L	8.4	10	41	100	20		
x	Hexachlorocyclopentadiene	8270C	Water	ug/L	1.6	10	10	100	20		
x	Hexachloroethane	8270C	Water	ug/L	8	10	34	100	20		
x	Indeno(1,2,3-cd)pyrene	8270C	Water	ug/L	5	10	41	140	20		
x	Isophorone	8270C	Water	ug/L	3.3	10	47	100	20		
x	Naphthalene	8270C	Water	ug/L	4.3	10	51	100	20		
x	Nitrobenzene	8270C	Water	ug/L	3.9	10	41	105	20		
x	n-Nitroso-di-n-propylamine	8270C	Water	ug/L	3.9	10	41	107	20		
x	n-Nitrosodiphenylamine	8270C	Water	ug/L	3.8	10	49	109	20		
x	Pentachlorophenol	8270C	Water	ug/L	4.6	50	50	112	20		
x	Phenanthrene	8270C	Water	ug/L	2.5	10	57	105	20		
x	Phenol	8270C	Water	ug/L	3.8	10	29	100	20		
x	Pyrene	8270C	Water	ug/L	3.9	10	43	118	20		
x	**Surrogate**										
x	2,4,6-Tribromophenol (surr)	8270C	Water	ug/L						29	126
x	2-Fluorobiphenyl (surr)	8270C	Water	ug/L						34	112
x	2-Fluorophenol (surr)	8270C	Water	ug/L						21	100
x	Nitrobenzene-d5 (surr)	8270C	Water	ug/L						38	113
x	Phenol-d5 (surr)	8270C	Water	ug/L						18	100
x	Terphenyl-d14 (surr)	8270C	Water	ug/L						10	119

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Filter	Method Description	Analytical Method	Test Matrix	Units	MDL	Lab RL	LCL	UCL	RPD	SLL	SUL
x	**Method: Semivolatile Organics (8270)**										
x	1,2,4-Trichlorobenzene	8270C	Solid	ug/Kg	49	330	53	107	20		
x	1,2-Dichlorobenzene	8270C	Solid	ug/Kg	86	330	49	104	20		
x	1,3-Dichlorobenzene	8270C	Solid	ug/Kg	93	330	48	100	20		
x	1,4-Dichlorobenzene	8270C	Solid	ug/Kg	74	330	50	100	20		
x	2,2-oxybis (1-chloropropane)	8270C	Solid	ug/Kg	172	330	48	100	20		
x	2,4,5-Trichlorophenol	8270C	Solid	ug/Kg	67	1700	62	118	20		
x	2,4,6-Trichlorophenol	8270C	Solid	ug/Kg	68	330	57	105	20		
x	2,4-Dichlorophenol	8270C	Solid	ug/Kg	57	330	58	103	20		
x	2,4-Dimethylphenol	8270C	Solid	ug/Kg	223	330	57	100	20		
x	2,4-Dinitrophenol	8270C	Solid	ug/Kg	197	1700	44	139	20		
x	2,4-Dinitrotoluene	8270C	Solid	ug/Kg	74	330	61	113	20		
x	2,6-Dinitrotoluene	8270C	Solid	ug/Kg	78	330	62	111	20		
x	2-Chloronaphthalene	8270C	Solid	ug/Kg	54	330	59	114	20		
x	2-Chlorophenol	8270C	Solid	ug/Kg	69	330	52	103	20		
x	2-Methylnaphthalene	8270C	Solid	ug/Kg	238	330	53	100	20		
x	2-Methylphenol (o-cresol)	8270C	Solid	ug/Kg	124	330	50	102	20		
x	2-Nitroaniline	8270C	Solid	ug/Kg	107	1700	55	106	20		
x	2-Nitrophenol	8270C	Solid	ug/Kg	77	330	53	102	20		
x	3,3-Dichlorobenzidine	8270C	Solid	ug/Kg	114	670	22	106	20		
x	3-Nitroaniline	8270C	Solid	ug/Kg	139	1700	28	100	20		
x	4,6-Dinitro-2-methylphenol	8270C	Solid	ug/Kg	141	1700	67	130	20		
x	4-Bromophenyl phenyl ether	8270C	Solid	ug/Kg	92	330	62	108	20		
x	4-Chloro-3-methylphenol	8270C	Solid	ug/Kg	85	330	56	110	20		
x	4-Chloroaniline	8270C	Solid	ug/Kg	127	330	15	114	20		
x	4-Chlorophenyl phenyl ether	8270C	Solid	ug/Kg	87	330	62	106	20		
x	4-Methylphenol (m/p-cresol)	8270C	Solid	ug/Kg	118	330	49	109	20		
x	4-Nitroaniline	8270C	Solid	ug/Kg	135	1700	32	111	20		
x	4-Nitrophenol	8270C	Solid	ug/Kg	366	1700	45	129	20		
x	Acenaphthene	8270C	Solid	ug/Kg	53	330	61	100	20		
x	Acenaphthylene	8270C	Solid	ug/Kg	55	330	60	102	20		
x	Anthracene	8270C	Solid	ug/Kg	73	330	63	107	20		
x	Benzidine	8270C	Solid	ug/Kg	1970	3300	10	100	20		
x	Benzo(a)anthracene	8270C	Solid	ug/Kg	53	330	62	109	20		
x	Benzo(a)pyrene	8270C	Solid	ug/Kg	58	330	53	121	20		
x	Benzo(b)fluoranthene	8270C	Solid	ug/Kg	108	330	52	124	20		
x	Benzo(ghi)perylene	8270C	Solid	ug/Kg	152	330	48	139	20		
x	Benzo(k)fluoranthene	8270C	Solid	ug/Kg	115	330	44	130	20		
x	Benzoic acid	8270C	Solid	ug/Kg	171	1700	40	143	20		
x	Benzyl alcohol	8270C	Solid	ug/Kg	103	330	14	150	20		
x	Bis(2-chloroethoxy)methane	8270C	Solid	ug/Kg	59	330	55	116	20		
x	Bis(2-chloroethyl)ether	8270C	Solid	ug/Kg	91	330	42	101	20		

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Filter	Method Description	Analytical Method	Test Matrix	Units	MDL	Lab RL	LCL	UCL	RPD	SLL	SUL
x	Bis(2-ethylhexyl)phthalate	8270C	Solid	ug/Kg	113	330	56	117	20		
x	Butyl benzyl phthalate	8270C	Solid	ug/Kg	115	330	56	113	20		
x	Carbazole	8270C	Solid	ug/Kg	85	330	62	104	20		
x	Chrysene	8270C	Solid	ug/Kg	40	330	60	106	20		
x	Dibenzo(a,h)anthracene	8270C	Solid	ug/Kg	112	330	55	131	20		
x	Dibenzofuran	8270C	Solid	ug/Kg	55	330	62	108	20		
x	Diethyl phthalate	8270C	Solid	ug/Kg	95	330	62	110	20		
x	Dimethyl phthalate	8270C	Solid	ug/Kg	75	330	63	105	20		
x	Di-n-butyl phthalate	8270C	Sólid	ug/Kg	72	330	58	117	20		
x	Di-n-octyl phthalate	8270C	Solid	ug/Kg	266	330	45	130	20		
x	Fluoranthene	8270C	Solid	ug/Kg	94	330	56	116	20		
x	Fluorene	8270C	Solid	ug/Kg	98	330	64	103	20		
x	Hexachlorobenzene	8270C	Solid	ug/Kg	71	330	62	105	20		
x	Hexachlorobutadiene	8270C	Solid	ug/Kg	69	330	52	118	20		
x	Hexachlorocyclopentadiene	8270C	Solid	ug/Kg	121	330	32	100	20		
x	Hexachloroethane	8270C	Solid	ug/Kg	78	330	46	100	20		
x	Indeno(1,2,3-cd)pyrene	8270C	Solid	ug/Kg	112	330	49	136	20		
x	Isophorone	8270C	Solid	ug/Kg	50	330	52	116	20		
x	Naphthalene	8270C	Solid	ug/Kg	64	330	57	100	20		
x	Nitrobenzene	8270C	Solid	ug/Kg	63	330	50	100	20		
x	n-Nitroso-di-n-propylamine	8270C	Solid	ug/Kg	101	330	49	138	20		
x	n-Nitrosodiphenylamine	8270C	Solid	ug/Kg	108	330	63	108	20		
x	Pentachlorophenol	8270C	Solid	ug/Kg	185	1700	43	122	20		
x	Phenanthrene	8270C	Solid	ug/Kg	69	330	64	108	20		
x	Phenol	8270C	Solid	ug/Kg	83	330	45	109	20		
x	Pyrene	8270C	Solid	ug/Kg	143	330	51	123	20		
x	**Surrogate**										
x	2,4,6-Tribromophenol (surr)	8270C	Solid	ug/Kg						41	126
x	2-Fluorobiphenyl (surr)	8270C	Solid	ug/Kg						38	121
x	2-Fluorophenol (surr)	8270C	Solid	ug/Kg						37	113
x	Nitrobenzene-d5 (surr)	8270C	Solid	ug/Kg						31	120
x	Phenol-d5 (surr)	8270C	Solid	ug/Kg						44	113
x	Terphenyl-d14 (surr)	8270C	Solid	ug/Kg						43	121

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Filter	Method Description	Analytical Method	Test Matrix	Units	MDL	Lab RL	LCL	UCL	RPD	SLL	SUL
x	**Method: Organic Carbon (9060)**										
x	Organic Carbon, Tot. (TOC)	9060	Water	mg/L	0.43	1					
x	**Method: Organic Carbon (Lloyd Kahn)**										
x	Total Organic Carbon (Soils)	Lloyd Kahn	Solid	mg/Kg	64	125	53	140	30		
x	**Method: Oil and Grease (Soxhlet Extraction) (9071)**										
x	Oil and Grease (HEM)	9071	Solid	mg/Kg	116	500					